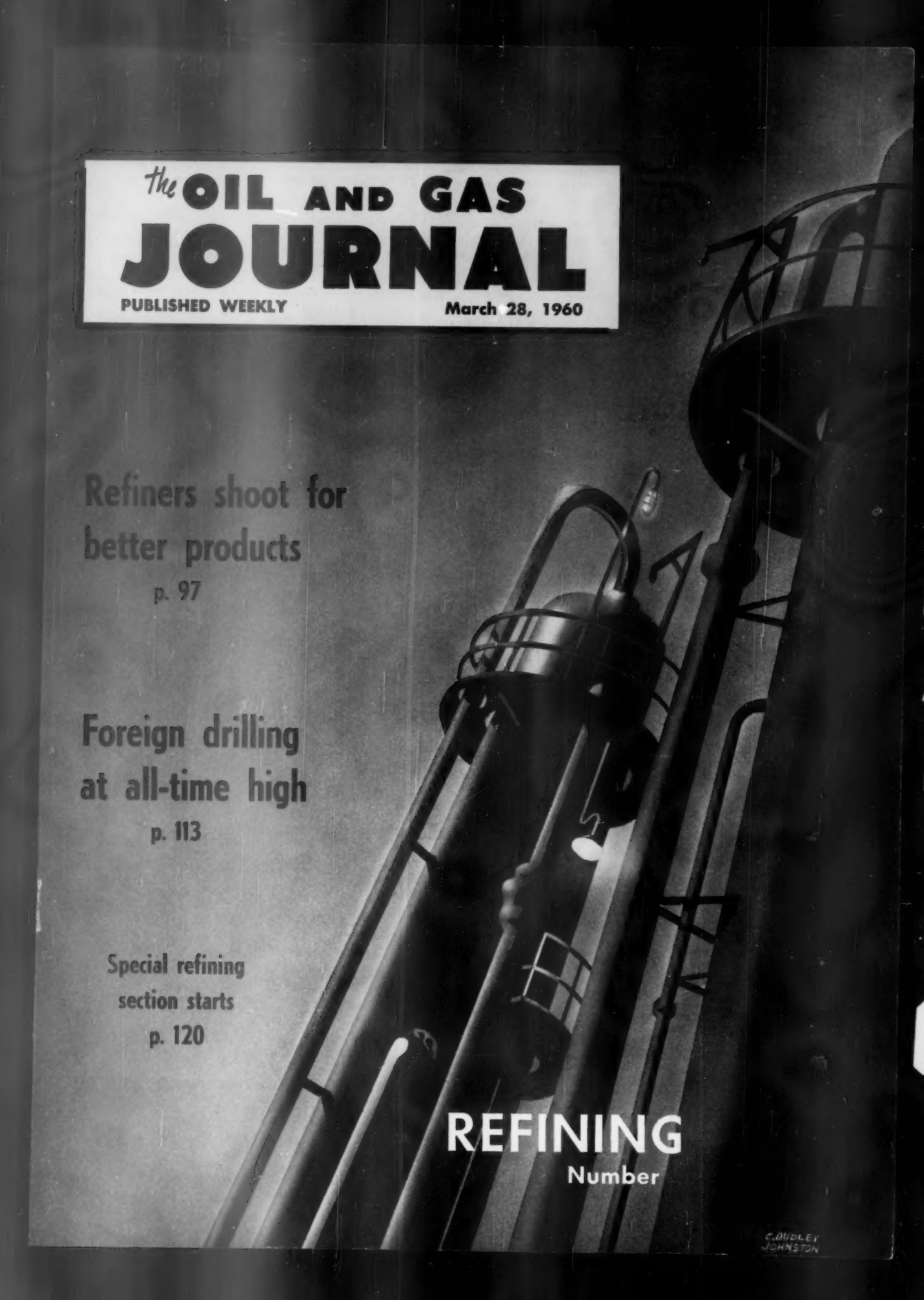
the OIL AND GAS JOURNAL
PUBLISHED WEEKLY
March 28, 1960



Refiners shoot for better products
p. 97

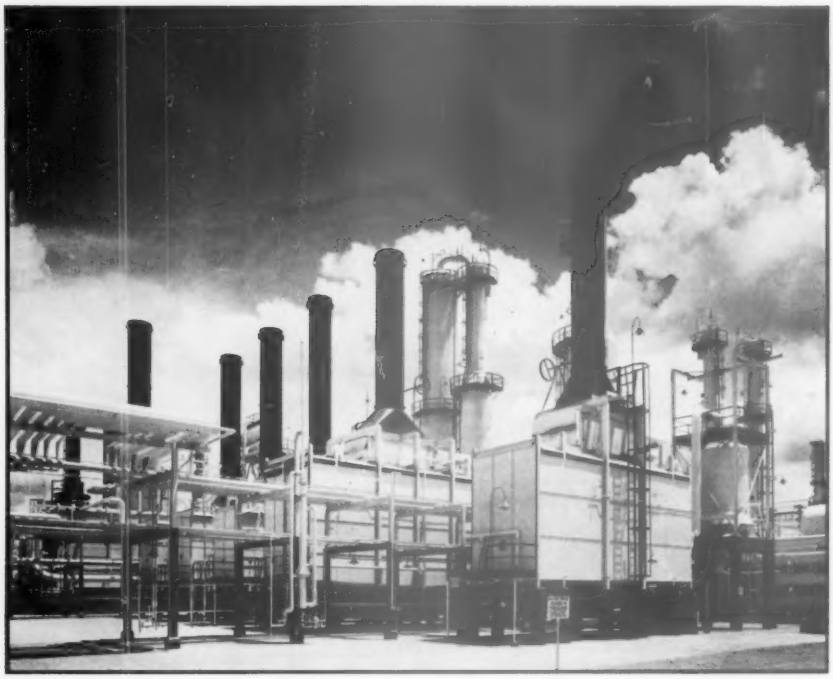
Foreign drilling at all-time high
p. 113

Special refining section starts
p. 120

REFINING
Number

C. DUDLEY JOHNSTON

BORN BUILDS BETTER HEATERS FOR REFINERIES



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(R)

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Vol. 58, No. 13

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SPECIAL REFINING SECTION

What's Ahead For Refining 120

Journal Staff Report

There's no big breakthrough in sight for refining. This represents the almost unanimous opinion of experts in all phases of the refining field. There are no startling new processes on the horizon. Neither is there particular need for any. Cheaper units, better product distribution, cheaper operation, and cheaper maintenance are the watchwords for the foreseeable future.

What's Ahead for the Sixties? 124

By M. P. Venema

The outlook for the 1960's is one of bustling activity and dynamic growth. A definite trend will be toward making greater volumes of higher-quality motor fuels, jet fuels, and petrochemicals. Specialty products will assume a growing importance.

Isocracking Upgrades Middle Distillates 127

By D. H. Stormont

A 1,000-bbl. Isocracking plant has been operated by Standard Oil Co. of California since last July. Yields and specifications of gasolines produced from a variety of charge stocks closely approximate pilot-plant yield structures. Versatility and operating simplicity of the plant are being demonstrated.

HDS Residual Processing Reduces Viscosity, Increases Quality 130

By H. Beuther, R. A. Flinn, and B. K. Schmid

Product can be sold as a low-sulfur-content fuel oil in either foreign or domestic operations, or a good yield of high-quality cracking stock can be removed in plants stressing gasoline production.

Computer Control of Catalytic Reforming Processes 133

By Reuben Silver

This 16-page special section gives a quick look at the reforming process, and how and why the computer can save the refiner money. Today computer control is an economic advantage; tomorrow it may be a necessity.

Annual Survey of Capacities of U. S. Refineries 149

The Journal's new 18-page survey is the latest and most complete in the industry, showing capacities of every operating plant in the U. S. as of January 1, 1960. The table includes a plant-by-plant listing of every type of process being used. State and national totals are given for each process.

Annual Survey of Capacities of Canadian Refineries 172

This three-page table lists capacities of every plant in Canada as of January 1, 1960. As in the U. S. survey, it shows types of processes in use at every plant, and gives country-wide and provincial totals for each process.

New Survey of Refinery Construction in the U. S. and Canada 177

Projects are currently under way, in the planning stage, or just recently completed at 66 plants in the U. S. and Canada. This survey of all refining companies shows 53 projects in the U. S. and 13 in Canada.

Plants Not Charging Whole Crude 186

Shutdown Plants in the U. S. and Canada 186

TECHNOLOGY—OPERATION

Let Preplanning Cut Your Drilling Costs 191

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German Crude Line Is Remote Controlled 194

By M. Swiss

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By E. A. Hartsook

Questions on Technology 206

Pipeline Construction Report 207

the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
March 28, 1960

Rotary rig activity is inching upward:

Number of rigs at work went up 32 last week to 1,683 active across the nation.

That's still not enough to recover much of the loss from a year ago. But spring is here now, and improvement in the weather will help.

The Blanpied report is in on exploratory drilling for last year in U. S. (p. 102).*

The score: 13,191 exploratory holes at total footage of 63,252,521 or average of 4,795 ft. per hole.

This is drop of 8 wells from 1958 but a sharp increase of 1,768,610 ft. of hole. Success ratio was 19.83% compared to 19.46% the year before.

Canadian drillers did much better in their wildcatting. About 31% of the 905 wildcats in western Canada were hits.

Rotary-rig activity abroad is setting record.

Drillers have 879 rigs at work in both exploration and development locations abroad—it's a jump of 25 rigs.

Red hot activity in Africa and the Persian Gulf are mainly responsible. Other shifts: Venezuela experiences a slowup and Argentina a pickup (p. 113).

Drilling in California coastal waters will double this summer when three new platforms are completed. Projects involve:

...Phillips-Pauley group starting development on their 3,840-acre Parcel E in the Point Conception area west of Santa Barbara.

...Texaco-Monterey using a template-type platform at nearby Parcel D.

...California Standard's second platform on its Summerland lease. It will be floated into position about June 1.

---

*Refers to article in this issue giving more details. Where no page is given, the item is a Newsletter exclusive.

Drillers have finally tapped the Moose Mountain structure 20 miles northwest of Turner Valley and 50 miles west of Calgary in Alberta's foothills region.

California Standard and Shell 16-6 Moose Mountain flowed 5 to 10 million cubic feet of gas daily from Mississippian at 7,376-7,769 ft., a 260-ft. section of pay.

Link may be established between the huge Mocane and Laverne gas districts.

Cabot Carbon will drill at 1-11 Barby Ranch Unit in Beaver County of the Oklahoma Panhandle. Location is in the last section without production between the two fields. The 5,900-ft. projected test thus could connect a producing area more than 25 miles wide and 60 miles long.

▼ ▼ ▼

Here's refinery picture revealed in Journal survey:

...Crude capacity at new high with 1.8% increase during year to 9,789,355 bbl. daily. This gives plenty of elbow room since refiners only operated at 82% of capacity in '59.

...Hydrogen treating capacity up 13.3% to 1,941,390 bbl. This important process for improving feedstocks now accounts for 19.8% of all crude processed.

...Catalytic reforming posted a 3.5% gain with addition of 64,000 bbl. daily capacity.

...Catalytic cracking advanced 5.7% with 231,000 bbl. additional built during year.

...Thermal capacity continued to decline.

...Alkylation, however, rose 10.1% with installation of 37,305 bbl. daily.

The outlook: Still higher compression ratios and thus higher octanes. Processes that will upgrade middle distillates and increase gasoline yields will be attractive (p. 97).

Petrochemicals will attract a $455-million investment in new production facilities during the 1959-61 period.

This is third place in latest survey of chemical-industry spending made by Manufacturing Chemical Association.

Period of labor peace may be ahead for oil industry.

How long this will last is an open question. But two recent events point to possibility organized labor will not be in a strike mood soon. They are: Defeat of OCAW in the Bayway refinery voting and OCAW loss of prestige in the long Sugar Creek strike (p. 104).

▼ ▼ ▼

First completely automated crude unit is taking shape at Indiana Standard's Whiting refinery.

The unit is rated at 140,000 bbl. daily and will be automatic when program now underway is completed.

The project is part of cost-cutting campaign in company. Other economy projects: Individual profit centers where control of operations and profits rests squarely with manager, new profitability techniques for control of investments and for measuring results, cutbacks in layers of supervision as well as the work force.

▼ ▼ ▼

The markets need a lift badly.

Product prices generally are weak. No cargo activity on light products on the Gulf Coast—not much demand either in other areas (p. 276).

Crude oil also is weak with more spot sellers than spot buyers. This weakness is exemplified by two trends:

...Price cutting showing up. Esso reduced Soso segregated lower cretaceous crude in Mississippi by 10 cents. The price is $3 bbl. for 40°-gravity with 2-cent differential. Suntide posted cuts ranging from 10 to 15 cents for heavy crudes in South Texas, putting top at $2.97.

...Purchaser proration is spreading. Indiana Standard and Sinclair both have reduced their crude buying by 20%. This involves production in the Rockies and Mid-Continent.

▼ ▼ ▼

Oil men will be interested in some of the problems owners are having with compact cars.

The headaches: Low gasoline mileage, tendency to burn up valves, high oil consumption, carburetor icing, and fuel-distribution problems.

Some auto experts think compacts may not be the answer but the motoring public eventually will settle on cars in the Dodge Dart class (p. 106).

Humble will start a service-station development program in Ohio about April 1. It's a key step in Humble goal of marketing in all 48 states.

The details: Headquarters will be in Columbus with two sales districts at Cleveland and Zanesville. Site acquisition and building planning have started. New Ohio division boss is James Cutz with Wesley Cooper as sales and operations manager. Products will come from Esso's Baton Rouge plant by barge.

▼ ▼ ▼

President Eisenhower says he still favors a gas bill but he doesn't see any point in pushing for one unless Congress indicates it favors action.

Careful phrasing of President's letter to Oklahoma Rep. Page Belcher makes one point clear: President does not plan to press for a bill even though he would support it "with full vigor" should a drive develop in Congress.

President's letter, however, was cheered by IPAA Chief

Alvin Hope, who indicated his group would push to get Congress to consider a gas bill this session.

Steam flooding may prove the key to increased oil recoveries from fields producing low-gravity crudes.

Shell's pilot project in the shallow Yorba Linda field near Los Angeles reportedly is showing excellent results.

Long Beach harbor department engineers also have planned a steam flood for a Small Tar sand pool in Wilmington.

▼ ▼ ▼

Border trouble may flare if Colombia approves applications for concessions in the Gulf of Venezuela near the head of Lake Maracaibo.

United Fruit and Colombia Cities Service each has applications pending on four offshore blocks. Boundary of three Cities Service blocks lies along a frontier still to be determined by Colombia and Venezuela.

Flow of Venezuelan crude has stopped to the unique "in bond" refinery of Petroleum Separating Co., Bayonne, N.J.

Last load—at least for now—of Maracaibo oil was processed at the 12,000-bbl. plant last week. Operators now are looking for a Middle East supply to keep the plant running.

Venezuela protested when officials discovered the plant was processing nearly 600,000 bbl. of Maracaibo crude bought at well below posted prices and then reshipping it to foreign markets, bypassing the need for a U.S. import quota.

Other foreign notes: Top Japanese rubber maker has a deal to import 135,000 tons annually of propane from Kuwait, hauling it in a new refrigerated tanker designed also to carry liquefied methane (p. 116)...Union Oil already is unloading drilling equipment and supplies for first drilling in Spanish Sahara...French have signed first contract for sale of Sahara crude to foreign company. Buyer is BP French subsidiary.

▼ ▼ ▼

E. Leland Richardson is a leading candidate for the FPC post left vacant by death of John B. Hussey.

Richardson, like Hussey, is from Louisiana. He is a prominent Baton Rouge attorney and oil man with experience and knowledge of the oil business.

A 110-mile crude pipeline costing $3.5 million is being planned in North Dakota by Great Northern Railway.

The road has applied to the North Dakota Public Service Commission for a permit. The line would serve Lignite and Newburg fields in Burke and Bottineau counties, linking them to the carrier's main line at Minot. Later, the pipeline may be extended to the Twin Cities and Duluth-Superior markets.

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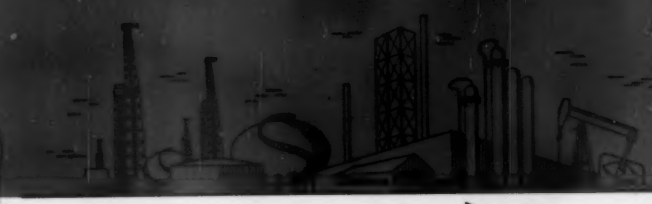

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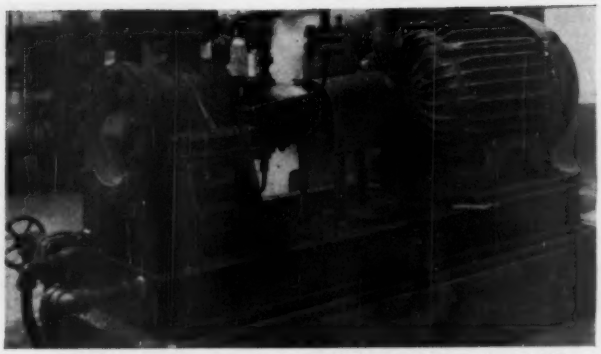
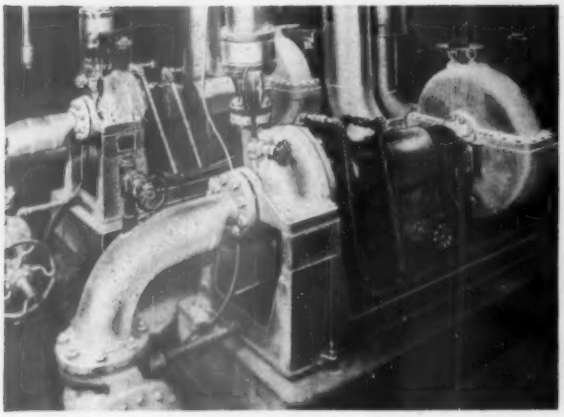
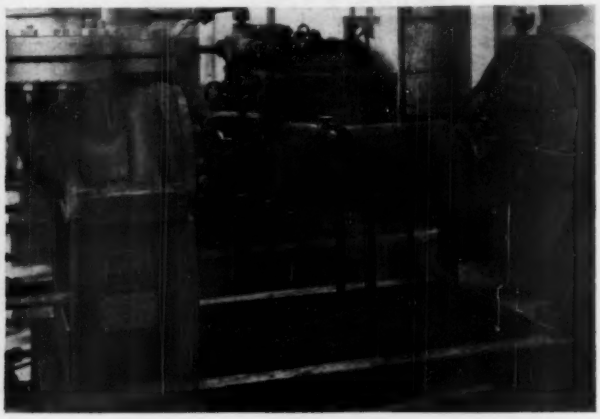


Size 1½" x 2" 2-stage pump handles light hydrocarbon mixture at 900 feet differential head operating at 3,500 rpm.



Size 2" x 3" x 13" pump handles 365 gpm of boiler feed water at 300 psi discharge pressure operating at 4,400 rpm.



Size 4" x 6" x 13" pump handles 780 gpm of hydrocarbonbutane mixture at 470 feet differential head operating at 3,500 rpm.

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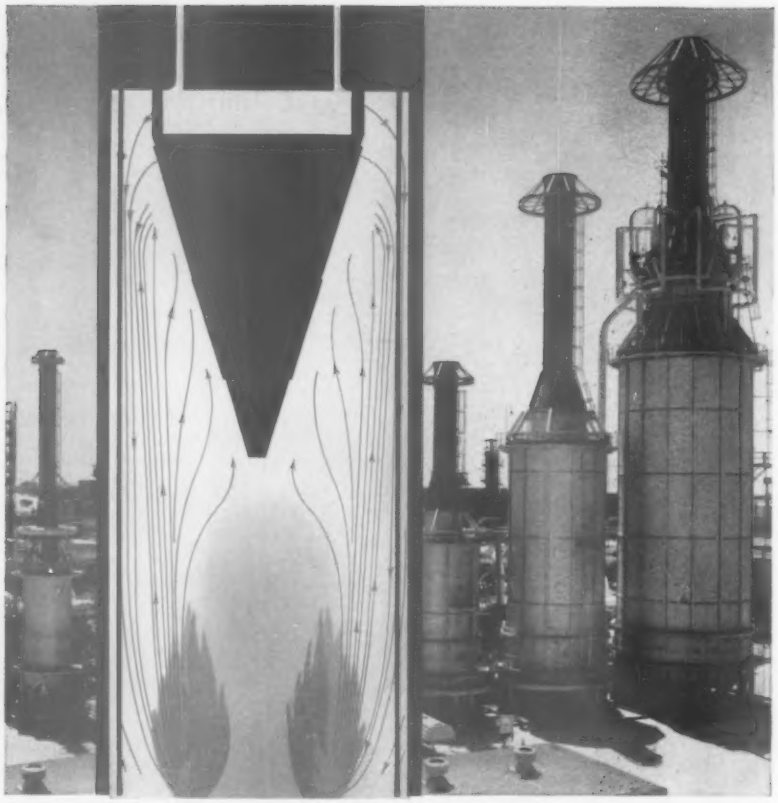

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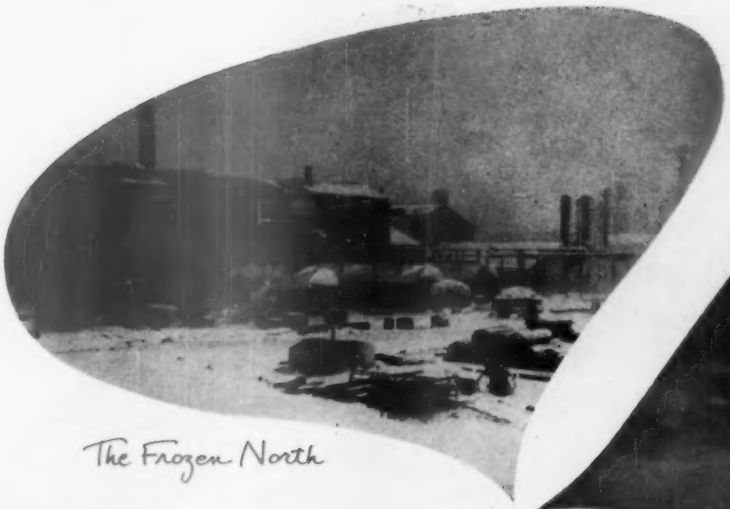

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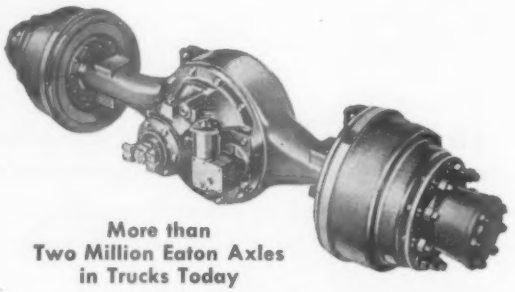

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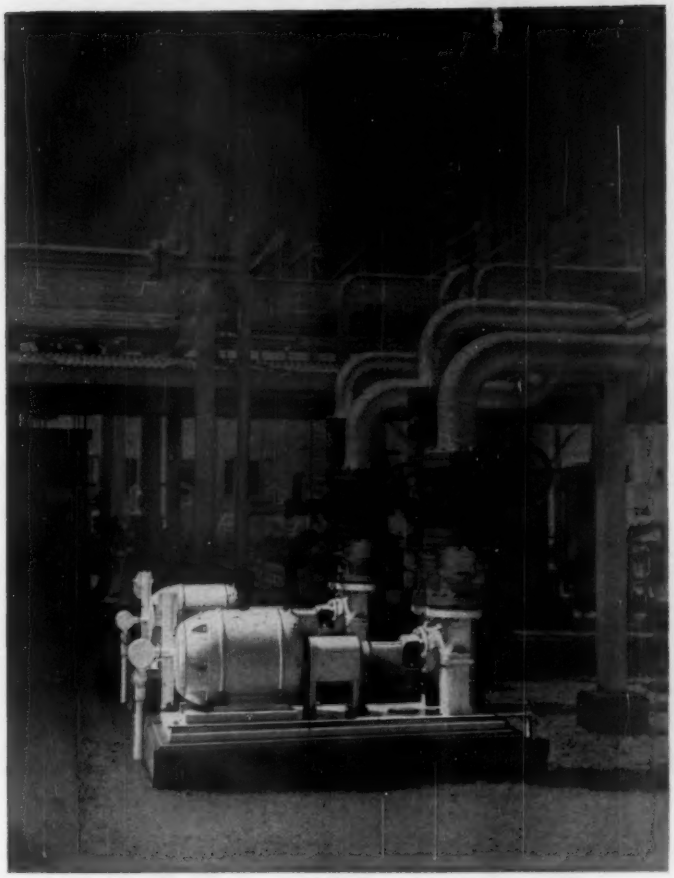


how I-R process pumps

CUT DOWN-TIME SAVE MAINTENANCE

RUGGED CASING for longer life. Centerline supported . . . recessed gasket for metal to metal fit . . . hydro-tested at twice the working pressure . . . generous corrosion allowance.

BALANCED ROTOR assures vibration-free operation. Hydraulic balance is attained by back ribs or back rings . . . Complete dynamic balance.

RIGID SHAFT prolongs seal and bearing life. Minimum deflection throughout the operating range . . . ground overall to final dimensions for close tolerance.

DEEP STUFFING BOX provides for effective sealing. Various packing arrangements depending on the service . . . mechanical seals can be engineered and applied to all pump sizes.

SPACER COUPLING simplifies maintenance. The pumping element and bearing housing can be removed as a single unit without disturbing the piping or driver.

A CENTURY 1860 — 1960 OF PUMP PROGRESS

FOR the complete story on I-R process pumps, contact your nearest I-R representative.

Ingersoll-Rand

100A10 11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

FALK and STEELFLEX are Registered Trademarks

Cut disconnect-reconnect time by as much as 50%

The FALK Spacer Coupling is specially designed for quick installation or removal *without disturbing the driving or driven unit.* This feature can save you up to 50% in disconnect-reconnect time when critical equipment—a process pump, for example—needs repair or replacement.

Here's another saving: with the FALK Spacer Coupling, you can quickly realign shafts *without the usual loss of operating temperature!*

And still another: you can remove or reinstall the FALK Spacer as a unit *without draining the lubricant.*

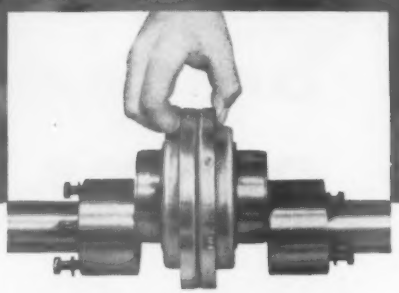
Because of its exclusive grid-groove Steelflex design, the FALK Spacer can accommodate residual misalignment—parallel, angular, or (most important) *both.* Also, it provides torsional resiliency that cushions shock and vibration. Thus it saves wear-and-tear on your connected equipment.

To prove these claims and enjoy these savings, install a FALK Spacer on one application—and see for yourself. Consult your FALK Representative or Authorized Distributor.

THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

Representatives and Distributors in many principal cities.

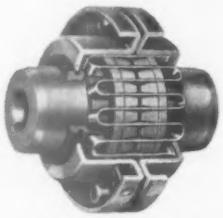


EASY AND QUICK TO INSTALL, DISCONNECT OR RECONNECT

First, mount shaft hubs to allow proper distance between hubs; then, align driving and driven units.

Second, compress Spacer to fit space between hubs and tighten cap screws to pull spacer hubs into the registered fit.

To disconnect, reverse the second step. No draining of lubricant necessary.



The heart of the FALK Spacer ...the basic Type F Steelflex

Write for Service Manual 4838

FALK

...a good name in industry

you get

REASSURANCE

with these HALLIBURTON Cementing tools!

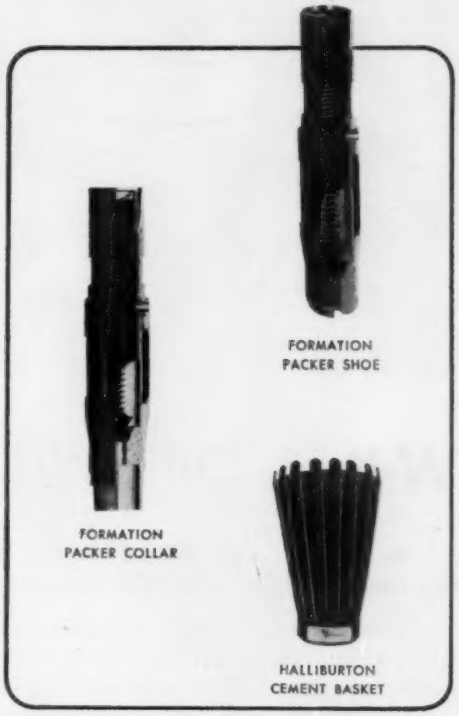
When cementing a well with weak or porous zones, you need the best available formation protection . . . against cement slurry from creating "formation damage" across the pay zone or to support the cement column and help prevent the slurry loss into any zone caused by a squeeze action from the cement's own weight. These Halliburton tools can aid in avoiding many of these and other potentially harmful problems. . . .

FORMATION PACKER SHOE – A unique combination tool **GUIDES AND FLOATS** the casing string in, using the dependable Halliburton Super Seal Float Valve . . . it provides **CIRCULATION** of fluid through the end of the casing shoe prior to setting . . . it **PACKS-OFF** the open hole below to help protect low pressure formations from cement contamination during cementing . . . and helps **PREVENT** cement slurry from backing up inside the casing above the Formation Packer Shoe by use of the super seal back pressure valve, a feature part of each tool.

FORMATION PACKER COLLAR – Similar in design to the Formation Packer Shoe, the packer collar is placed a few joints off bottom . . . to help **PREVENT** cement entry into a lower formation. May be used in setting liners, perforated pipe and screen in salt water disposal wells, or in waterflooding projects and for full hole cementing.

HALLIBURTON CEMENT BASKET – An inexpensive but very dependable tool when placed at one or more points on the casing string or liner . . . helps to **PROTECT** weak or porous formations from fluid or cement slurry entry . . . also helps **SUPPORT** the column of cement above until it takes the initial set.

These features are typical of the attention to detail in research, design and engineering that becomes a part of every Halliburton product.



Ask your Halliburton Representative about these Effective, Efficient Tools! Available in all popular casing and liner hole sizes.

HALLIBURTON CEMENTING SERVICES

HALLIBURTON OIL WELL CEMENTING COMPANY—DUNCAN, OKLAHOMA

275 SERVICE CENTERS—JUST MINUTES AWAY FROM YOUR WELL

"We wouldn't use any other valve!"

W-K-M® Oil Field Valves

No other valves give the same dependable service and lifetime economy. No other valves seal so tight.

W-K-M's Controlled Force Seating creates an initial bubble-tight seal between the gate and Teflon inserts. As the gate assembly expands, a tight metal-to-metal seal is achieved. Result: a perfect *Double Tight Seal* without body or seat lubrication.

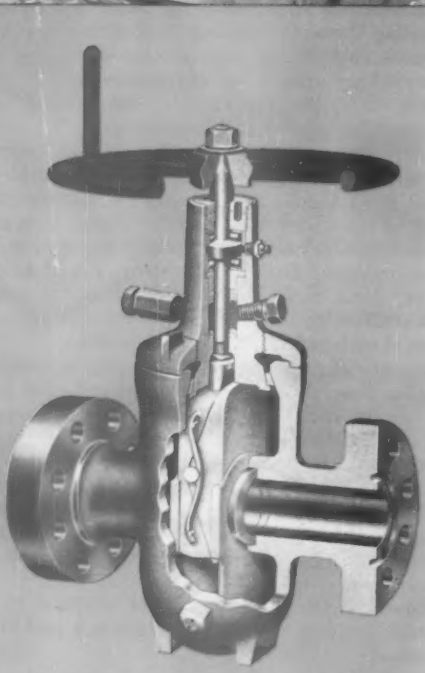
Next time—and every time—specify W-K-M! *Available at leading supply stores everywhere.*

PRODUCT OF W-K-M's *Creative Engineering*

WRITE FOR CATALOG 200

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS



W-K-M Through-Conduit Gate Valves feature pressure seal bonnets, superfinished stems supported on roller bearings, seating surfaces sealed from the lading flow — and can be overhauled on-the-line.

Sizes: 2", 2½", 3" and 4".

Working Pressures: 1000-5000 psi (model illustrated above); other models 500 to 15,000 psi.

5917-R

To all leading Oil Companies

GKN supply bolting material to refineries all over the world. This includes Alloy Steel Stud Bolts, Carbon Steel Stud Bolts, Alloy Steel Studs and Carbon Steel Studs, and Carbon Steel Bolts and Nuts to specifications laid down in BS.1750 and BS.1506.

if it's a matter of how to fasten one thing to another . . .
get in touch with **GKN**

GUEST KEEN & NETTLEFOLDS (MIDLANDS) LTD. BOLT AND NUT DIVISION: ATLAS WORKS, DARLASTON, S. STAFFS, ENGLAND

D/ST.B/707

YOU NAME THE MUD SPERSENE THINS IT.....

	Weight—lb./gal.	Viscosity—sec./qt.	Gel Strength—Initial/10 min. lb./100 sq. ft.	Fluid Loss—cc.
Gyp mud	19.0	63	0-3	3.9
Lime mud	12.7	53	0-0	5.0
Saturated salt mud	15.0	64	0-4	2.8
Sea water mud	10.8	40	1-4	7.4

The chart tells the story. Based on mud reports of actual drilling wells, it gives conclusive evidence that Spersene® controls viscosity and gel strengths in different types of drilling fluids. The facts prove that Spersene is highly effective in gyp, lime, and salty muds.

Spersene permits the use of high weight gyp muds for deep drilling. The low alkalinity of gyp-Spersene muds improves stability at high temperatures. And, Spersene is soluble in fresh and **salt** water.

Spersene is one more tool developed by Magcobar Technology. The Magcobar mud engineer knows Spersene, knows how to use it right for highest performance. He can help you plan your drilling program with Spersene for maximum economy.

So, wherever you drill, begin planning with Magcobar. You'll find that Magcobar Technology combines the finest engineering skills with high performance products to avoid costly trouble in drilling to let you drill at the lowest cost per foot every foot of the way.

Magcobar
Complete
DRILLING MUD SERVICE

DRESSER INDUSTRIES, INC.
OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL

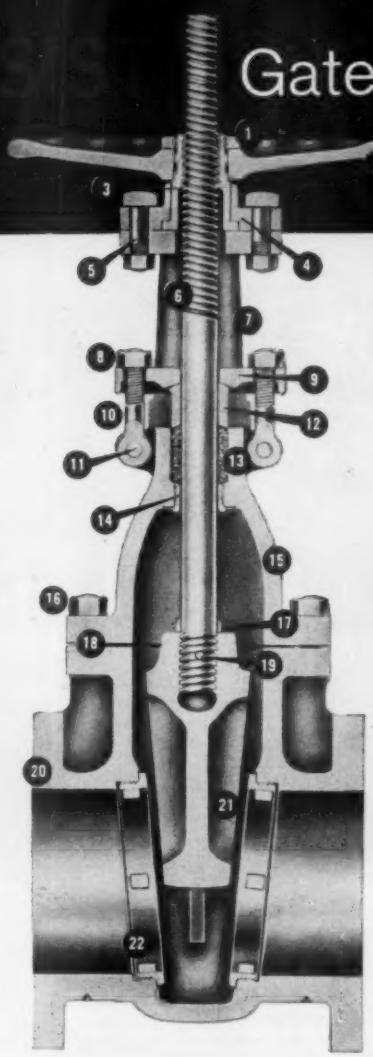
MAGNET COVE BARIUM CORP.
HOUSTON

Well Done
With Magcobar
Technology

You extend valve life
in Corrosive and Erosive services
TWO WAYS when you

Specify for

Gate Valves, too



No. 1... when you specify "Jenkins" you get not merely "Ni-Resist" metal but you get Type 2 Ni-Resist Cast Iron! That affords extra resistance to acids, salt and alkaline solutions, sea water, brine and other corrosive and erosive fluids, vapors or gases. It is copper-free and will not contaminate or discolor the materials controlled.

Type 316 Stainless Steel is used for the wedge, spindle and other trimmings to give you a combination of metals which have remarkable ability to withstand destructive service.

No. 2... you get all the excellence which the Jenkins Diamond trademark has represented for nearly a century. The superior design and construction are visible here. Equally important superiorities which show up only in the records of long service and low maintenance are the close grain and high density of Jenkins castings ... the precision of Jenkins machining ... the rigid inspection and testing which every Diamond-marked valve undergoes.

It costs no more to buy Ni-Resist Gates made by Jenkins. And, it may cost much less to USE them. Write us, or ask your Jenkins Distributor for information folder No. 205.

1 Bronze yoke bushing nut
2 Handy grip iron wheel
3 Bronze yoke bushing
4 Iron yoke cap with zerk fitting for lubricating bushing
5 Steel yoke cap bolts and nuts
6 TYPE 316 STAINLESS STEEL spindle
7 NI-RESIST CAST IRON, TYPE 2, yoke
8 Bronze eye bolt nuts
9 Malleable iron gland flange
10 Steel gland eye bolts
11 Steel gland lug bolts and nuts
12 TYPE 316 STAINLESS STEEL gland
13 Teflon impregnated asbestos packing
14 TYPE 316 STAINLESS STEEL bonnet bushing
15 NI-RESIST CAST IRON, TYPE 2, bonnet
16 Steel bonnet bolts and nuts
17 TYPE 316 STAINLESS STEEL spindle ring
18 Asbestos gasket
19 TYPE 316 STAINLESS STEEL wedge pin
20 NI-RESIST CAST IRON, TYPE 2, through-port body
21 TYPE 316 STAINLESS STEEL solid I-beam wedge
22 TYPE 316 STAINLESS STEEL seat rings

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864 Jenkins Bros.

Sold Through Leading Distributors Everywhere

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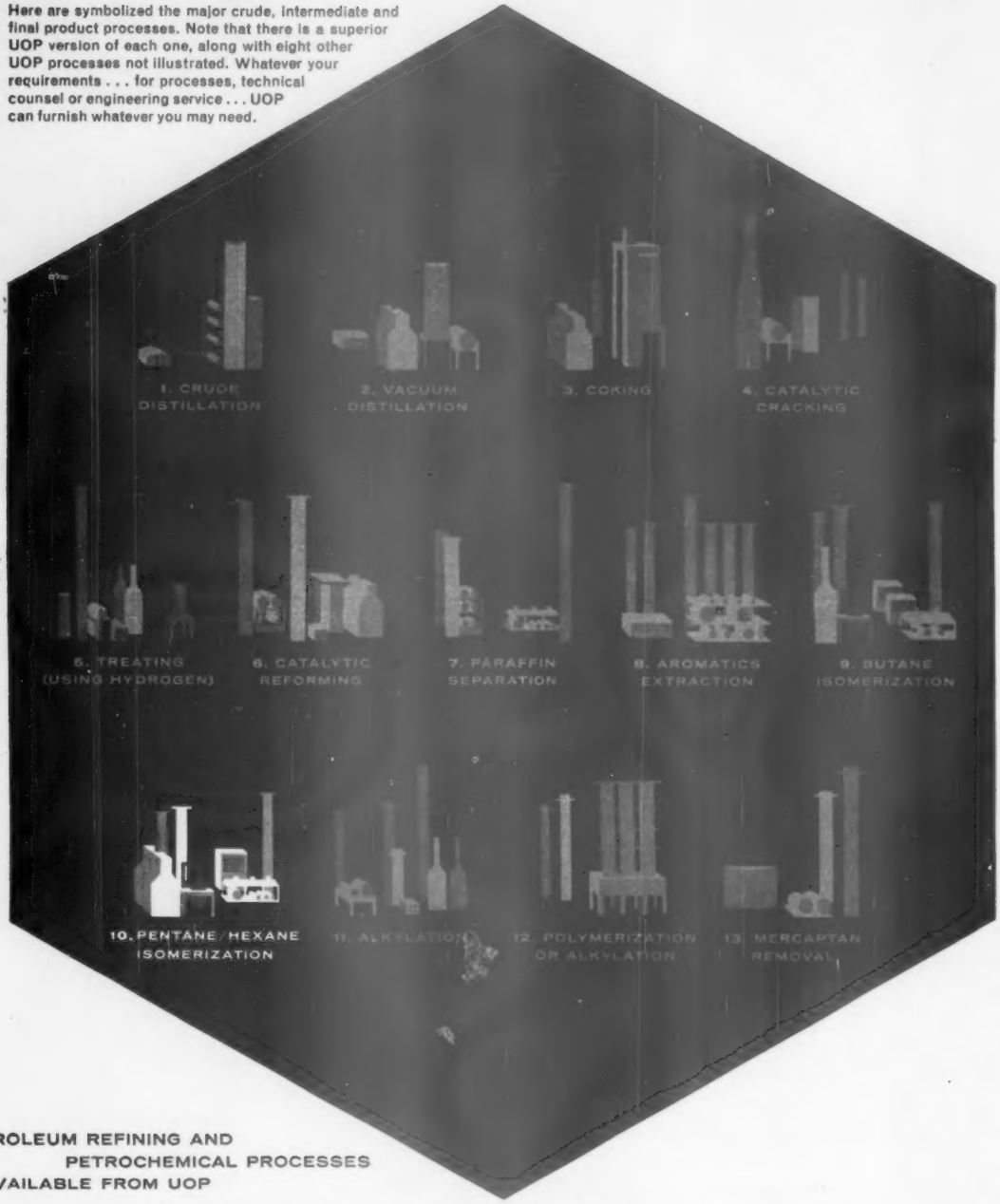
Send folder No. 205 describing Ni-Resist Gate Valves

Name & Title .....

Company .....

Address .....

Here are symbolized the major crude, intermediate and final product processes. Note that there is a superior UOP version of each one, along with eight other UOP processes not illustrated. Whatever your requirements . . . for processes, technical counsel or engineering service . . . UOP can furnish whatever you may need.



PETROLEUM REFINING AND PETROCHEMICAL PROCESSES AVAILABLE FROM UOP

1. CRUDE DISTILLATION equipment is designed and engineered by UOP in any desired capacity.

2. VACUUM DISTILLATION and **VISBREAKING**—easy-to-operate processes for preparation of feed stocks for catalytic cracking.

3. L.P. COKING permits adjustment of gasoline-to-heavy oils production ratio to meet market needs.

4. FLUID CATALYTIC CRACKING—an improved process that gives higher yields, higher octane numbers.

5. UNIFINING™—a modern process that completely purifies petroleum distillates.

6. PLATFORMING® produces high octane gasolines, high purity aromatics.

7. MOLEX™—a new continuous separating process that removes lowest-grade hydrocarbons from gasoline.

8. UDEX®—the ideal process for separation of super-purity aromatics.

9. BUTAMER™—a new and practical process for producing isobutane.

10. PENEX®—a new process that converts light, normal paraffins to isoparaffins.

11. HF ALKYLATION—makes alkylate, top anti-rumble motor fuel. Sulfuric acid process also available.

12. CATALYTIC CONDENSATION—converts olefin fractions of refinery gases into high-quality gasoline and petrochemicals.

13. MEROX™—a new and inexpensive treating process to remove mercaptans from gasolines and light distillates.

PROCESSES NOT ILLUSTRATED:

REXFORMING®—the ideal process to insure your top octane position.

CATALYTIC DEHYDROGENATION—removes hydrogen from hydrocarbons to produce less-saturated hydrocarbons.

HYDEAL™—a new process for the hydrodealkylation of toluene or C_9 aromatics to produce benzene; may also be used for manufacturing phenol and naphthalene.

HYDRAR™—converts benzene to cyclohexane with excellent yields, achieves extreme high purity with Udex grade benzene.

OLEFIN EXTRACTION—efficiently separates olefins and diolefins from paraffins; prepares olefins for further conversion.

AROSORB™—removes heavier aromatics from synthetic and natural distillates, produces aromatic-free heavier distillates.

ALKAR™—produces ethylbenzene, cumene and other alkylated aromatics from Fluid Cat Cracker off-gas streams.

UNISOL®—an economical process for treating high mercaptan-containing gasolines.

'62 COULD BE
THE YEAR
FOR YOU!

Choose from 21 possible ways to brighten your profit picture . . .

Which of these fuels will you find most profitable to produce . . . motor . . . aviation . . . jet . . . diesel . . . heating? Two years from now you will want to be one of the forward-looking refiners who adjusted his position to take advantage of a greatly changed situation.

Regardless of the kind of products you presently produce, you should take steps to assure yourself a more profitable future, *now*. Universal can furnish any of 21 different processes, one or more of which could prove to be ideally suited to your needs.

But UOP service does not start, nor end, with a process. An economic and market study can help you develop interesting and significant data indicating the most practical steps to take . . . and what changes or additions to your present process facilities will prove most profitable, now and for the future.

Start now . . . plan for '62.

THE CONSENSUS OF INFORMED OPINION is that 1962 will require a substantial increase in process capacity . . . NOW is the time to start your planning!

UOP®
UNIVERSAL OIL PRODUCTS COMPANY
30 Algonquin Road, Des Plaines, Illinois, U.S.A.
WHERE RESEARCH TODAY MEANS PROGRESS TOMORROW

PHOTO COURTSEY OF ATLAS PROCESSING CO.

PENEX®

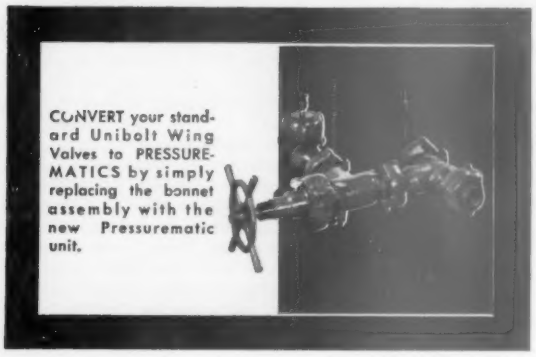
Specifically designed for the continuous catalytic isomerization of normal pentane, normal hexane and mixtures of both, Penex enables the refiner, for the first time, to economically upgrade these low-grade fractions, providing a high-octane blending component of excellent quality. In the Penex process, reaction of the fixed-bed platinum-containing catalyst permits extremely mild operating conditions, while the non-corrosive nature of the catalyst assures easy, economical and long-sustained operation. Conditions are so selected that regeneration is not required, thus reducing capital investment costs, simplifying operation and reducing maintenance.

NOW, YOU CAN MAKE YOUR XMAS TREES SAFER THAN EVER!

The New Unibolt Pressurematic Wing Valve

- ***Automatically shuts in the well when flowline pressures rise or fall beyond desired limits.***
- ***Permits manual operation for choke changing.***

A broken flowline or the failure of any unit in the separator, heater-treater, or gathering manifold that would cause the flowline pressure to *drop,* would automatically and instantly close the Pressurematic Wing Valve and shut in the well. Any obstruction in the flowline, such as paraffin, that would cause the flowline pressure to *rise,* would also actuate the Pressurematic Valve to closed position.


CONVERT your standard Unibolt Wing Valves to PRESSUREMATICS by simply replacing the bonnet assembly with the new Pressurematic unit.

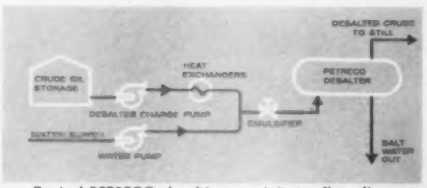
No springs are employed in the Pressurematic Valve. Its design incorporates the long-established engineering principle of balancing a small diameter piston which is exposed to high pressure (wellhead) against a large diameter piston which is exposed to low pressure (flowline). When this balance is disturbed — in excess of pre-determined limits — the pistons move and thus actuate the gate, or stem. This movement is to the closed position only. When the valve closes it can be opened with the handwheel and reset for automatic operation. The handwheel also permits manual operation of the valve for choke changing, etc.

Complete details will gladly be sent on request.

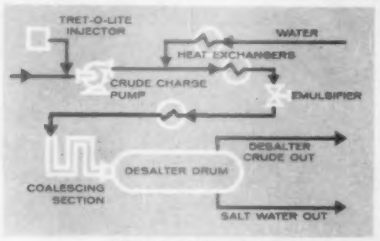
THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

How PETRECO Processes Work...

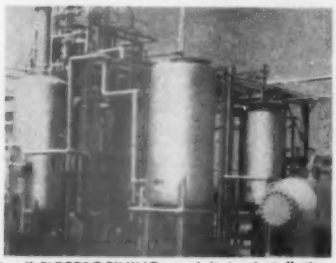
TO IMPROVE PRODUCTS... CUT TREATING COSTS



Typical PETRECO desalting precipitator flow diagram.



TRET-O-LITE desalting flow diagram.



Small ELECTROFINING precipitator installation.

BENDER sweetening installation.

** Trademarks, Petrolite Corporation*

PETRECO *Electric Desalting*

The crude charge is pumped through a heat source with temperatures in the 225-275°F. range, then mixed with a small quantity of water and emulsified. Resulting water-in-oil emulsion is then dispersed into high-potential electrostatic field. Powerful coalescing action forces intimate association of impurities (salts and other solids) with water. Water is then quickly and automatically separated and withdrawn. Purified crude continues into refinery flow.

Tret-O-litE **Chemical Desalting*

Chemical is injected into suction side of charge pump to assure dispersion. Wash water (about 5% of oil volume) is added to oil-chemical mixture following the charge pump. This oil-chemical-water mix is raised to operating temperature and water-to-oil contact attained by passing through emulsifying valve following heat exchangers. Resulting emulsion then goes through coalescing section where water droplets grow to size that permits separation. Mixture then enters desalting vessel, salt-in-water separates from hydrocarbon phase. Purified crude proceeds to usual distillation equipment.

ELECTROFINING **Precipitators*

In this treatment, the distillate is intimately and intensively contacted with a predetermined amount of treating chemical. Controlled intimacy of contact minimizes treating time. The hydrocarbon and treating chemical phases then are rapidly separated by the precipitating action of the strong electrostatic field. With ELECTROFINING* Precipitators, distillate stocks can be treated with caustic to remove acids, hydrogen sulfide, lighter mercaptans, gum-forming components. Cracked stocks can be treated to remove cresols and thiocresols. Sulfuric acid treatment removes sulfur compounds, gum and sediment forming materials, nitrogen bases, arsenic, lead, etc.

BENDER Catalytic Sweetening

Controlled quantities of sulfur, alkali and air are added to the charge stream, then passed through a PETRECO* catalyst bed. The mercaptans are converted to disulfides by oxidation. The resulting product is sweet and non-corrosive. The BENDER process is simple, continuous and automatic.

OTHER PETRECO PROCESSES INCLUDE:

PETRECO *Dehydration
PETRECO *Desaponification
PETRECO *Sediment Separation

FOR MORE INFORMATION on any of these treating processes, contact your local Petreco service engineer, or write...

AR-60-2

PETROLITE CORPORATION

PETRECO DIVISION
3202 South Wayside Drive (P.O. Box 2546), Houston 1, Texas
1390 East Burnett Street (P.O. Box 7216), Long Beach 7, California

CANADA: Petreco, 4528 Stanley Drive, Calgary, Alberta
COLOMBIA: South American Petrolite Corporation, Bogota
ENGLAND: Petrolite Limited, 20 Savile Row, London W.1
GERMANY: Petrolite Anlagenbau und Vertriebsgesellschaft m.b.H., Frankfurt a. M.
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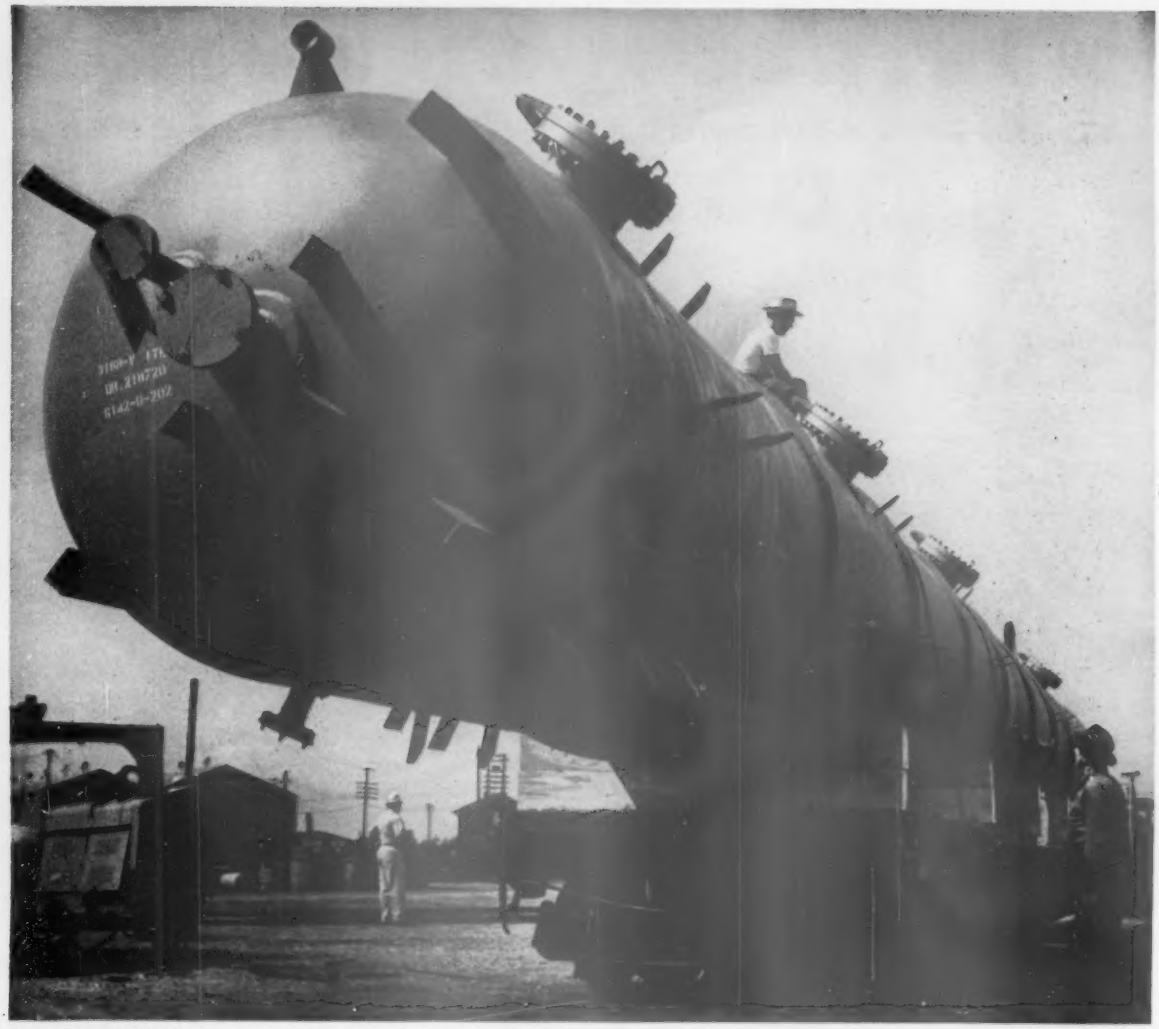


THIS ENTIRE VESSEL was radiographed. Built for use by Socony Mobil Oil Company, Incorporated, it was stress relieved in thirds, and the two joints were stress relieved locally. The unit contains 30 uniflex trays of 96" diameter. Overall weight: 152,000 lbs.

Among the largest in use

...*built by* Newport News

This Debutanizer with a 110 feet 6 inches over-all length is typical of units that are readily built by Newport News . . .

In fact, Newport News can fabricate almost any type of pressure vessel or other heavy equipment used in the petroleum, chemical or other processing industries.

But at Newport News you'll find more than large productive capacity.

In vast fabricating shops, in huge machine shops, foundries and forging plants, Newport News craftsmen complete your order with specialized techniques. Plant methods . . . developed as a result of specializing for more than half a century . . . enable Newport News to provide money-saving answers to all sorts of heavy equipment problems.

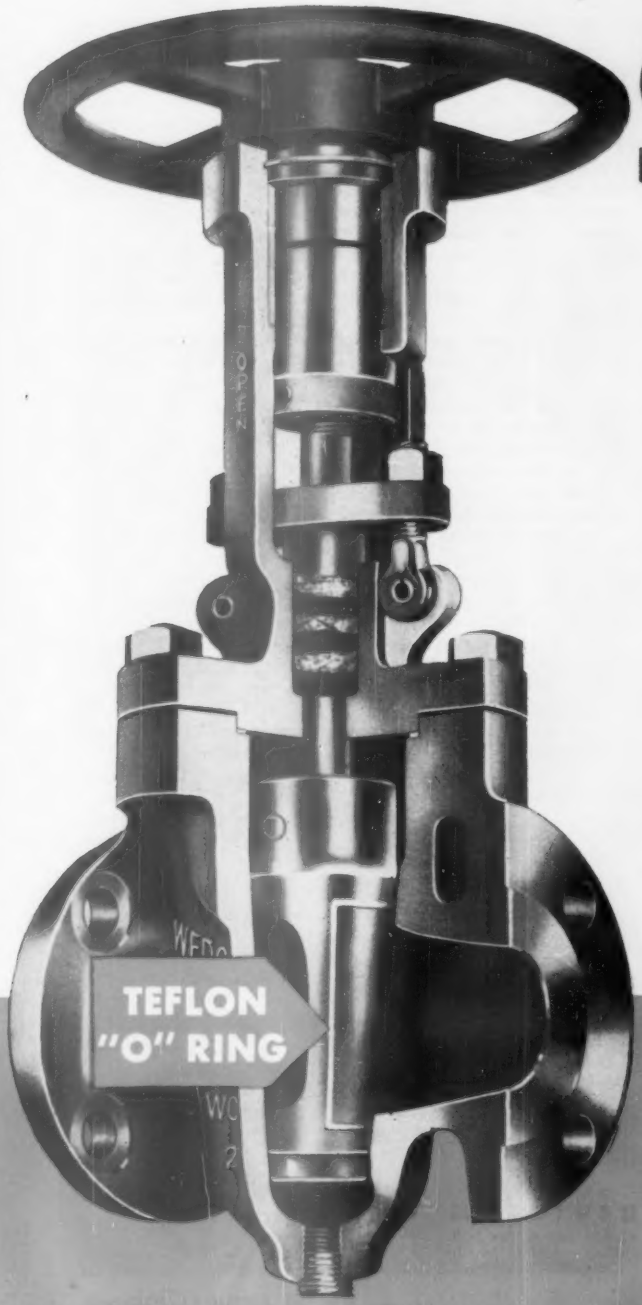
Newport News craftsmen handle the job exactly as you want it done . . . for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and Products"...it's yours for the asking.

Engineers — Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia

BIGGEST MONEY SAVER

In The Valve Industry!



You're familiar with the expense involved in the lubrication of plug valves — the high monthly cost of man hours, grease and equipment, or of a lubrication service. The contaminating influence of the lubricant is also a constant hazard. Not to mention the sticking and leakage that occur when lubrication of a particular valve is overlooked.

These are some of the reasons why Stockham's Wedgeplug "O-Seal" Valve is rapidly replacing lubricated valves in general purpose services everywhere.

The other reason is, simply, that the non-lubricated "O-Seal" equals or betters the performance of any lubricated valve — without costing a cent for maintenance.

Two Teflon† "O" rings in the plug provide absolute shut-off — shut-off that remains permanently "bubble-tight" on both the upstream and downstream seats. Thus, the "O-Seal" provides double-block and bleed in most services. The "O-Seal" has proven itself absolutely leakproof on hundreds of services.

Flawless machining of metal seats provides shut-off in case of fire — double seating for double *safety*. And the "O-Seal" is *guaranteed not to stick.*

Call your Stockham Distributor or Sales Representative now, or write Stockham for complete details about how you'll save money — from now on — with

Stockham's NON-LUBRICATED Wedgeplug* "O-Seal" Valve

Complete ranges of sizes and types available.

†Teflon, Dupont Trademark *Patented

WEDGEPLUG VALVE COMPANY
DIVISION OF

STOCKHAM
VALVES *and* FITTINGS

General Offices and Plant
4002 North 10th Avenue Birmingham 2, Alabama

CAST IRON-MALLEABLE AND DUCTILE IRON PIPE FITTINGS — BRONZE, CAST IRON, DUCTILE IRON, CAST AND FORGED STEEL VALVES
Sold Only Through Distributors

CONTACTOR 2

GLYCOL PROCESS DESIGN AND OPERATING INFORMATION

Proper use of glycols in well designed, correctly operated equipment is essential for efficient gas treating. Some of these important design and operating considerations will be discussed in this series.

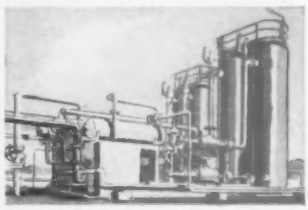
Glycol Injection Units

Units discussed in this issue of Allied Chemical Contactor are those using glycols to prevent hydrate formation when low temperatures are used to increase recovery of liquifiable hydrocarbons.

Type of Glycol for Use

Either ethylene or diethylene glycol may be used in glycol injection recovery units. Triethylene glycol is *not* recommended because of its high solubility in liquid hydrocarbons.

Both ethylene and diethylene glycol offer certain advantages depending on desired characteristics. Ethylene glycol has a higher vapor pressure, which means a greater vapor loss . . . yet it has a lower solubility in liquid hydrocarbons. Thus, losses are essentially equal for both chemicals. Ethylene glycol is less viscous than diethylene glycol, and its eutectic mixture with water has a lower freezing point than does the diethylene glycol eutectic.



Separation of Glycol and Hydrocarbon

Optimum temperature for separation of glycol and hydrocarbons is in the range of 40-60° F. High losses can occur if the streams are heated above 100° F prior to separation. At the other extreme – temperatures below 20° F – it is very difficult to separate glycol and hydrocarbon streams because they are practically insoluble. Entrainment of the glycol in the exit hydrocarbon stream will cause high losses of glycol. If it *is* mandatory to separate at low temperatures, long residence times or very efficient agglomerating separators should be used.

Amount of Glycol to Inject

To prevent hydrate formation, it is possible to inject as little as one-half gallon per hour per mmcfd; for greater dehydration, most operators prefer to inject one gallon of glycol per hour per mmcfd.

Mechanics of Injection

Use of spray nozzles for atomization of the glycol when it is introduced into the natural gas is recommended. Operating experience has shown that several joints of pipe will effect a very thorough mixing of glycol and gas, provided flow is in the turbulent region.

Care should be taken to prevent layering of glycol where the chiller is of the shell and tube type. Assure complete mixing of the glycol in the gas.

Care of Glycol

Like any process, good operation dictates that proper care be taken of the glycol used for hydrate inhibition. Frequent checks on the pH of the glycol should be made. Practically all of the degradation products of glycols are acids, being predominantly formic and acetic acid; and though none have been reported, it seems likely that dibasic acids could be produced by degeneration. If the pH of a glycol unit is not carefully watched the solution can become very acidic which will cause the solution to be corrosive. A buffer should be employed that will keep the pH at 7.2.

A black gum very often forms in glycol units. The presence of hydrocarbons seems to speed the rate of formation of this material, and hydrocarbons may be a reactant. The formation almost always occurs at a low pH and could be an ester (or even possibly a polyester). This material when deposited is very hard and brittle, but exists in the glycol as a very fine suspension. We believe that the removal and control of this material is essential to proper glycol unit operation.

In most of these systems a very convenient buffer is monoethanolamine. MEA is a fairly strong base and will yield soluble salts with the acids formed in these units. Another reason for the use of MEA is that it is a film former and will serve as a corrosion inhibitor. Care should be exercised when using MEA in this manner so that too much is not used. At a pH of around 8.5, a solution of glycol and MEA may foam very badly.

Another important step to be taken in the care of glycol solutions is the proper filtration of the solution. As mentioned, an accumulation of gum and silt in a glycol solution is an invitation to trouble. Glycol is a very difficult material to filter and one possible way might be to use a self cleaning type filter in combination with a packed filter. Longer and more complete operation would be obtained in this manner.

FOR MORE INFORMATION, look for future issues of Allied Chemical Contactor featuring articles on ethanolamines and glycols in gas treating operations.

We will gladly send technical data, delivery and price information on Allied Chemical Ethanolamines and Ethylene Glycols.

For specifications and local offices, see our insert in Chemical Materials Catalog, pages 475-482 and in Chemical Week Buyers Guide, pages 37-44.

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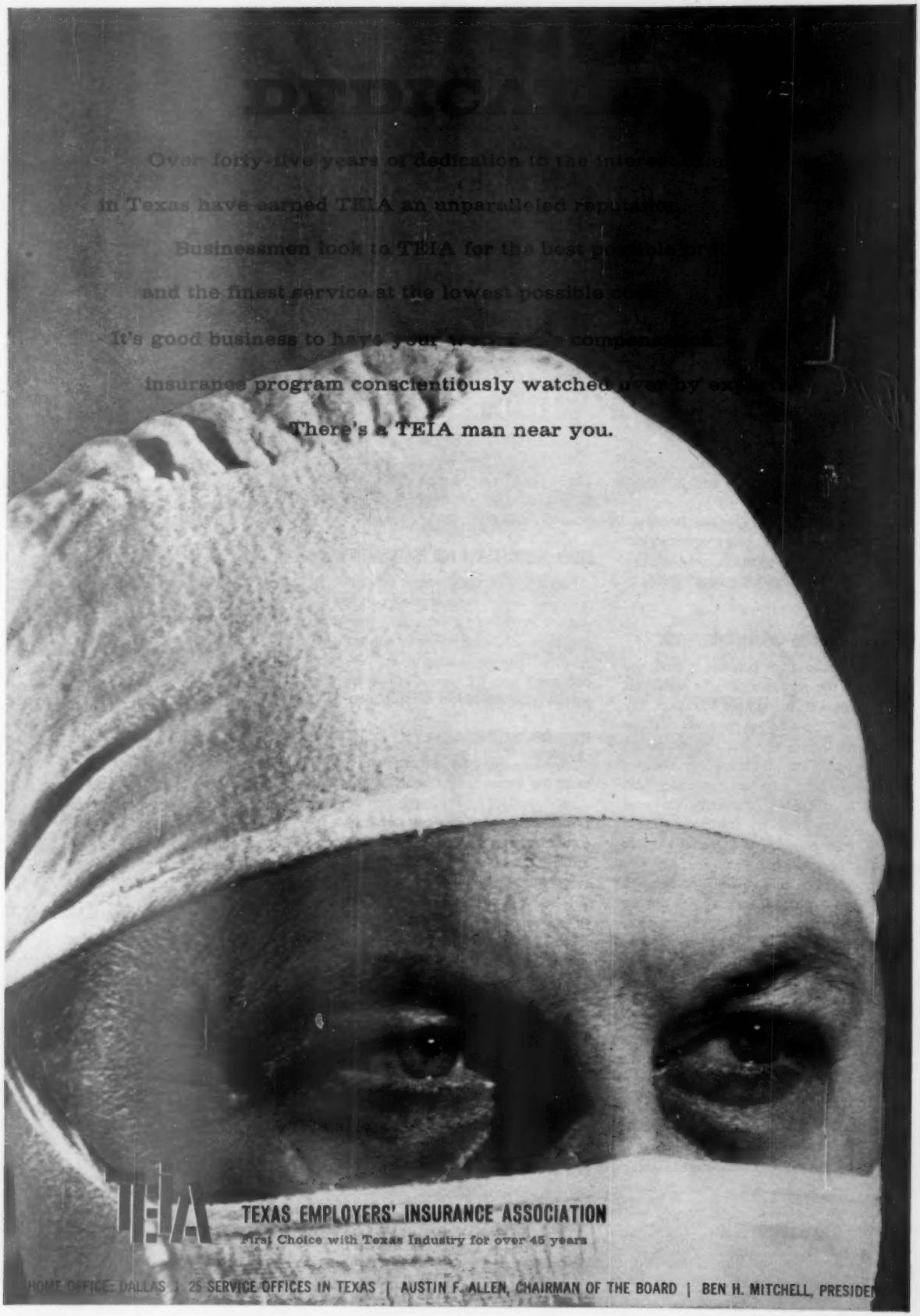
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Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

REDUCE GAS-SWEETENING COSTS

Two simple control tests increase plant efficiencies

Chemical analysis is the only quick and efficient method of gauging the operating efficiencies of plants that use monoethanolamine to sweeten natural gas. By proper interpretation of the simple, yet accurate tests, plants can be operated more efficiently and at some cost saving.

Quick titrations can give this information and enable the plant operator to keep safely below solution overloading, thus minimizing corrosion and solution contamination.

TEST NO. 1—ACID GAS CONCENTRATION

The total acid gas content of both the rich and the regenerated lean solutions is determined by simple titration. By comparing the acid gas contents of these solutions, before and after regeneration, the regeneration efficiency and the net solution loading can be determined. This net solution loading (the amount of acid gas removed by the solution) should check with an acid gas material balance around the absorber.

An excess of acid gas in both the rich and lean solution indicates solution overloading or improper regeneration.

When the rich solution loading is high, while the lean solution loading is quite modest (here indicating good regeneration), one of three things may be at fault: (1) Insufficient scrubber fluid circulation; (2) Insufficient amine concentration; (3) either more gas is being processed than anticipated, or the acid gas content is higher than originally expected.

An excess of acid gas in the lean solution, when the rich solution is not overloaded, indicates improper regeneration or severe solution contamination.

STEAM REQUIREMENTS FOR REGENERATION

Enough stripping vapor should be provided to the regeneration column to remove essentially all the acid gas from the rich solution before it enters the reboiler. Normal steam rates vary between 0.8 and 1.2 pounds of steam per gallon of amine solution circulated.

FLUID CIRCULATION

In plants with all carbon steel equipment the amine solution circulation rate should be adequate to keep the net solution loading at or below 0.4 moles of total acid gas (CO_2+H_2S) per mole of monoethanolamine. Under these conditions, in the conventional plant, the rich solution will contain less than 0.5 moles of total acid gas per mole of amine; and the lean solution will contain 0.1 or less moles of total acid gas per mole of amine.

Contamination can be controlled by a side stream distillation unit that removes foreign materials and amine degradation products.

TEST NO. 2—MONOETHANOLAMINE CONCENTRATION

By titrating a sample of the lean solution with standard HCl, to a pH of 4.5, the per cent of monoethanolamine free for acid gas absorbtion can be determined. This information allows for proper control of amine concentration and, therefore, proper setting of the circulation rate.

OTHER TESTS

Union Carbide has for many years maintained laboratories for the examination of scrubber solutions, and for basic research in gas treating technology. These are two of many analytical tests described in the paper "An Approach to Monoethanolamine Solution Control: Chemical Analysis and Its Interpretation." This paper relates chemical analysis to plant operation and suggests remedial steps found effective in eliminating operational difficulties. For a copy, use the coupon provided.

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UNION CARBIDE CHEMICALS COMPANY
Dept. G, 30 East 42nd Street, New York 17, New York

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- ☐ Have a representative call.
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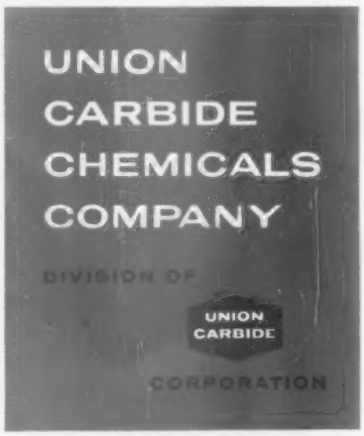

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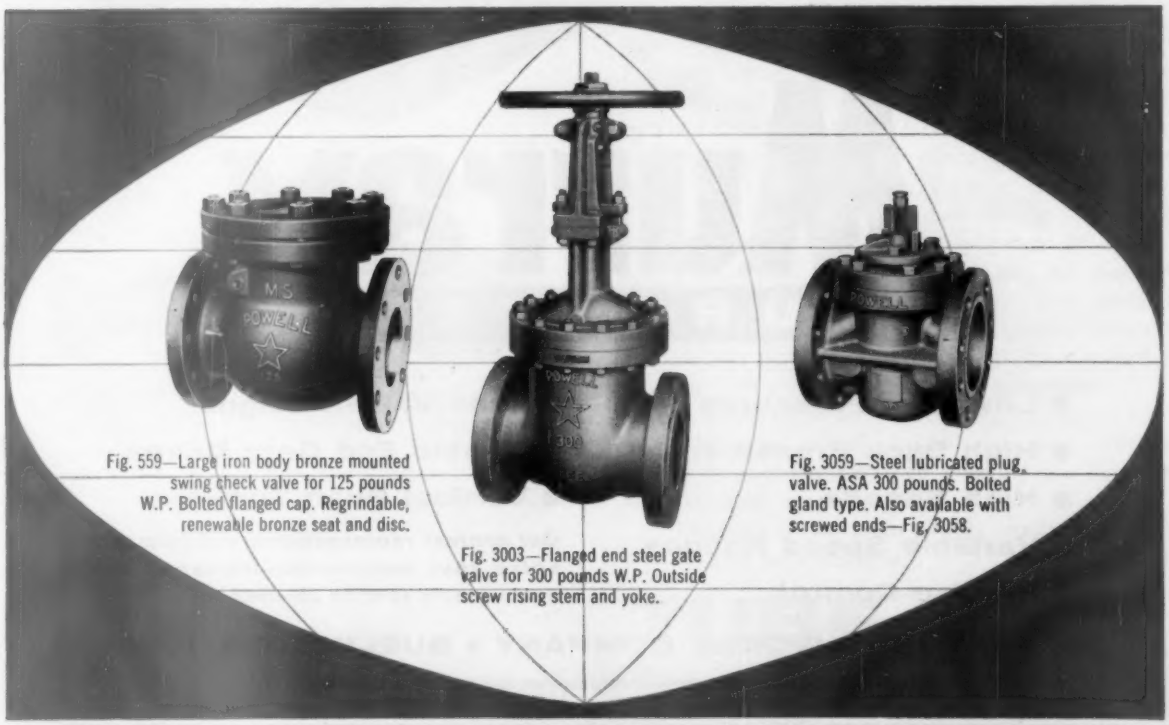

Fig. 559—Large iron body bronze mounted swing check valve for 125 pounds W.P. Bolted flanged cap. Regrindable, renewable bronze seat and disc.

Fig. 3003—Flanged end steel gate valve for 300 pounds W.P. Outside screw rising stem and yoke.

Fig. 3059—Steel lubricated plug valve. ASA 300 pounds. Bolted gland type. Also available with screwed ends—Fig. 3058.

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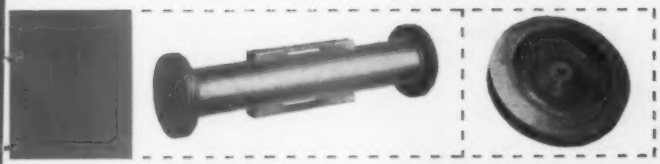

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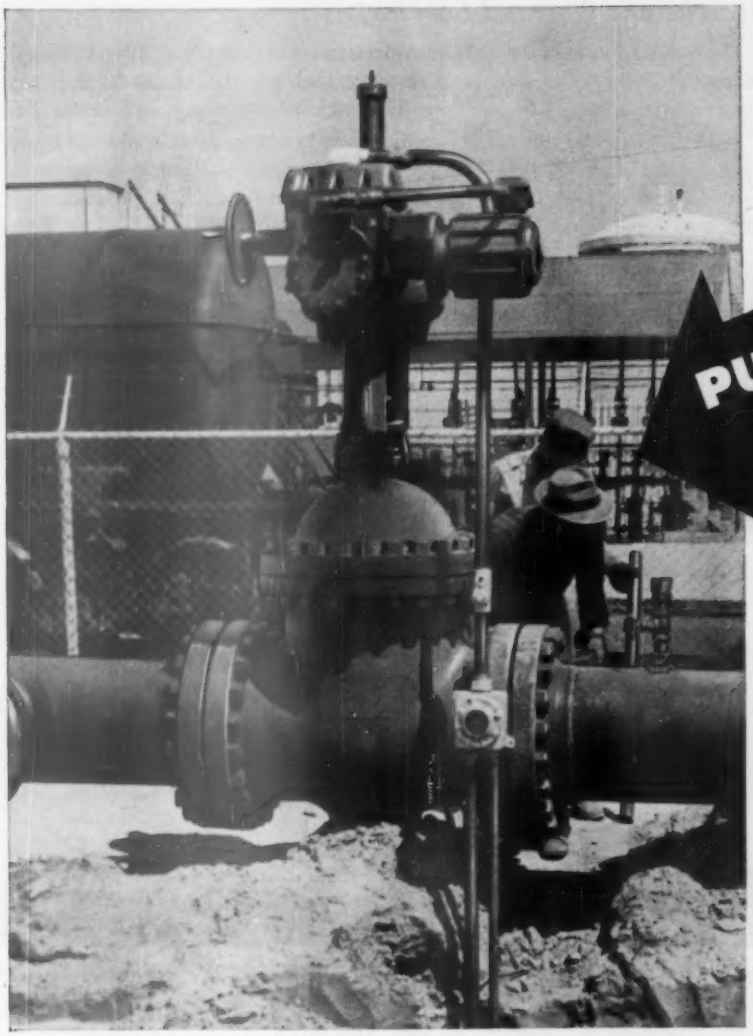

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"The key to progress, therefore, is freedom for men to continue to dream, plan, invent and experiment with new ideas, new tools and new methods in a never ceasing effort always to do their jobs better.

"As suppliers of the nation's basic energy source, oil men must continue in this traditionally progressive spirit. Never before has the need been greater than today for the utilization of better tools and advanced techniques in the recovery of oil and gas as a result of increasingly complex drilling and production problems.

"In meeting this challenge, the technical men engaged in oil production join with the manufacturing, service and supply companies to provide the equipment, the technological advances, the methods and the services that are vital to the discovery of an oil field and its economically successful development. Vigorous and forward-looking, these companies exemplify the resourcefulness that has helped our industry contribute so greatly to higher standards of living for all mankind."

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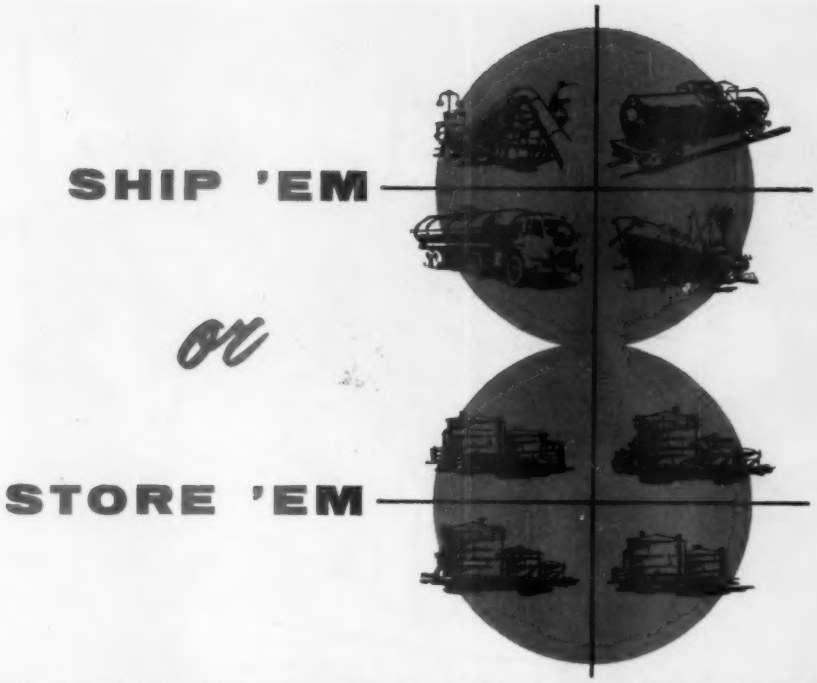

NALCO-TREATED FUEL OILS STAY FRESH!

Get rid of the hurry-up-and-sell pressure caused by unstable fuel oils that darken and sludge up when stored or shipped any distance. New Nalco 303-AC is the fuel oil dispersant-stabilizer that gives you *best* control of sludging tendencies—keeps fuel oils refinery-fresh, bright, and sludge-free even when shipped thousands of miles and stored for months.

Ask for product information on this new chemical for distillate fuels. It is available promptly from your Nalco Representative, or from Nalco direct.

National Aluminate Corporation is now

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Fuel oil at *left* is fresh from refinery, bright and clear. *Center*, Nalco-treated oil is bright and sludge-free after four months. *Right*, untreated sample in four months time has darkened considerably, already begun to sludge.

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DU PONT *Petroleum Chemicals* NEWS

Number 101 in a Series of Bulletins for the Petroleum Industry

MARCH-APRIL 1960

FOA-2 a money saver on many fronts

IN MARKETING

Worriers are good customers for service stations

Skilled psychological researchers, visiting service stations, querying customers and attendants, listening in to their questions and answers, found that motorists worry about *almost everything* concerning their cars . . . and, as you would expect, women worry about *everything*.

How to turn these worries into positive selling points is the subject of a series of four new folders DuPont makes available for your dealer meetings.

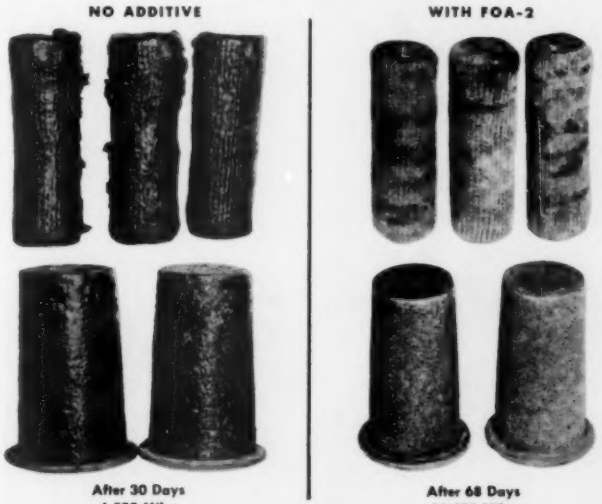
PSSST....about women customers who worry about everything
PSSST.* about customers who worry about lube jobs
PSSST.* about customers who worry about motor oil and oil changes
PSSST.* about customers who worry about the condition of their tires

The four folders are concerned with those who worry about their tires, oil and oil changes, lube jobs, and lastly, the multiple worries of women. Each contains tips on how to put those worries to rest. The theory behind it all being that "If you save them worry . . . they'll save their business for you."

Refiners, large and small users, all enjoy savings

DuPont Fuel Oil Additive No. 2 provides a wide range of benefits for refiners, distributors and users. It ends the multiplying costs of sludge and gum formations which penalize everyone. Simple and economical to use, it is effective throughout the whole range of distillate fuels. Refiners have found the benefits of FOA-2 more than pay for the cost of addition.

FIGURE 10
FOA-2 RETARDS FILTER PLUGGING IN DIESEL LOCOMOTIVES



In the refinery

FOA-2 added to catalytic cracked fuel oils produces a stable product, at a fraction of the cost of other means.

It can be used to overcome incompatibility that may be encountered when blending catalytically-cracked and straight-run fuel oils.

Added to residual fuels *before* they go into storage, FOA-2 will reduce or prevent costly mechanical cleaning of storage facilities. The product may also be used gradually to disperse sludge which may already be present.

CONTINUED OTHER SIDE

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT *Petroleum Chemicals* NEWS

CONTINUED *FOA-2*

Fuel Oil Customers

It has been found that FOA-2 effects a major reduction in home heating service calls. It minimizes oil burner ignition failures . . . keeps the oil free-flowing and clean burning . . . ends sludge formation in tanks, filters and nozzles. Being a nonmetallic *ashless* additive, it does not leave ash deposits to foul operation of the stack controls or ignition system.

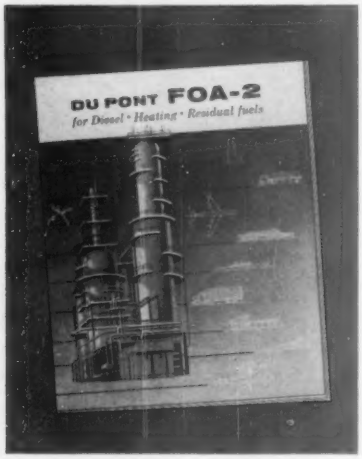
In storage, stocks accumulated during the summer remain satisfactory for winter consumption.

Users of residual fuels find that FOA-2 keeps their fuel storage and supply systems clean and burners operating smoothly.

Diesel Operators

Railroads and other large users of diesel fuels appreciate the economy of cracked distillates stabilized with FOA-2. Filterability is improved and injector sticking problems are reduced.

Being a nonmetallic additive, it does not add to the exhaust stack sparking problem.



FOA-2 with DMD

Pre-mixed combinations of FOA-2 and DuPont Metal Deactivator are widely used. FOA-208 contains 8% DMD while FOA-212 contains 12% DMD.

A 24-page brochure on FOA-2 with information on properties, concentrations, handling, uses, etc., is available.

Your Petroleum Chemicals Representative will be glad to furnish you with copies of this brochure as well as additional technical information and samples for use with your own stocks, or write Petroleum Chemicals Division in Wilmington.

Golden Gate Office gets new manager

JAMES G. McILHINEY, a veteran with a diversified background in the Petroleum Chemicals Division, and a San Francisco sales representative for more than a year, is now Manager of the San Francisco District.

In his twelve years with DuPont, Mr. McIlhiney has worked closely with many oil companies in a wide variety of marketing, technical and safety areas. He brings to his present post a thorough knowledge of conditions and needs in the field.

Born in Jersey City, N. J., he went to Cornell University, graduating in 1935 with a degree in Mechanical Engineering. Before joining DuPont he was associated with Air Reduction Sales Company as a sales representative and engineering specialist.

With DuPont he has been a sales service representative in the Eastern and Gulf Coast regions. In 1955 he was assigned to the division's technical group in Wilmington, Delaware. He also represented the Petroleum Chemicals Division in the Mid-Continent Region where he remained until early in 1957. Since then he has been a familiar figure in the bay area refineries.

High effectiveness at low concentrations characterizes "Ortholeum" 302 Antioxidant

New DuPont "Ortholeum" 302 antioxidant has proved, in laboratory evaluations, to be more highly effective at considerably lower concentrations than other currently-used oxidation inhibitors.

A general purpose ashless antioxidant, it is effective as a stabilizer for greases, turbine oils, crankcase oils and synthetic lubricants.

Tests have shown that "Ortholeum" 302 frequently will provide stability for greases which fail to respond to normal concentrations of conventional antioxidants.

In turbine oils concentrations as low as 0.05 to 0.10% by weight are often more effective than higher concentrations of other antioxidants.

Tests have also suggested that "Ortholeum" 302 may prove useful as an auxiliary additive to other antioxidants in crankcase oils. Experiments with a concentration of 0.25 weight per cent in a 400 SUS solvent extracted neutral oil indicated that it did an excellent job minimizing bearing corrosion in a double-length L-4 Chevrolet engine test.

In some synthetic oils, "Ortholeum" 302 frequently exceeds the performance of widely accepted synthetic oil antioxidants in controlling viscosity changes, copper corrosion, and acid number when the oils are subjected to high-temperature oxidation tests.

Your DuPont Petroleum Chemicals Division representative will be glad to supply more information and samples.

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Du Pont Tetraethyl Lead and other Petroleum Additives

OVER

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A-13616

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Bethlehem Wire Rope Serves Work-Over Job in Northward Field—This is a recent work-over job by the J. C. Lewis Drilling Company on Well 15 in the Northward Field, near Wickett, Texas. The Bethlehem wire ropes were 5,500 ft of 7/8-in. 6 x 21 Type U Plow, right lay, with fibre core, and 5,000 ft of 9/16-in. 6 x 7 Formset, Purple Strand, right lay, with fibre core. As usual, the rope provided top-notch performance—one of the reasons why it's a favorite with drillers everywhere.

Bethlehem Steel Company, Bethlehem, Pa. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem Wire Rope

BETHLEHEM STEEL

It's Foxboro Consotrols

PHOTOGRAPHY BY ROBERT A. PACKO, TOLEDO

†Completely integrated Sohio Toledo unit has a refining capacity of 60,000 bbls. per day. The 13-acre facility requires only 17 operators per shift—was designed and built by the M. W Kellogg Company.

for SOHIO

Reliable instrument performance a "must" at fully-integrated Toledo Refinery

Crude in at one end — finished product out the other—one continuous operation. That's the process flow at Standard Oil of Ohio's new 60,000 bbl. Toledo Refinery.

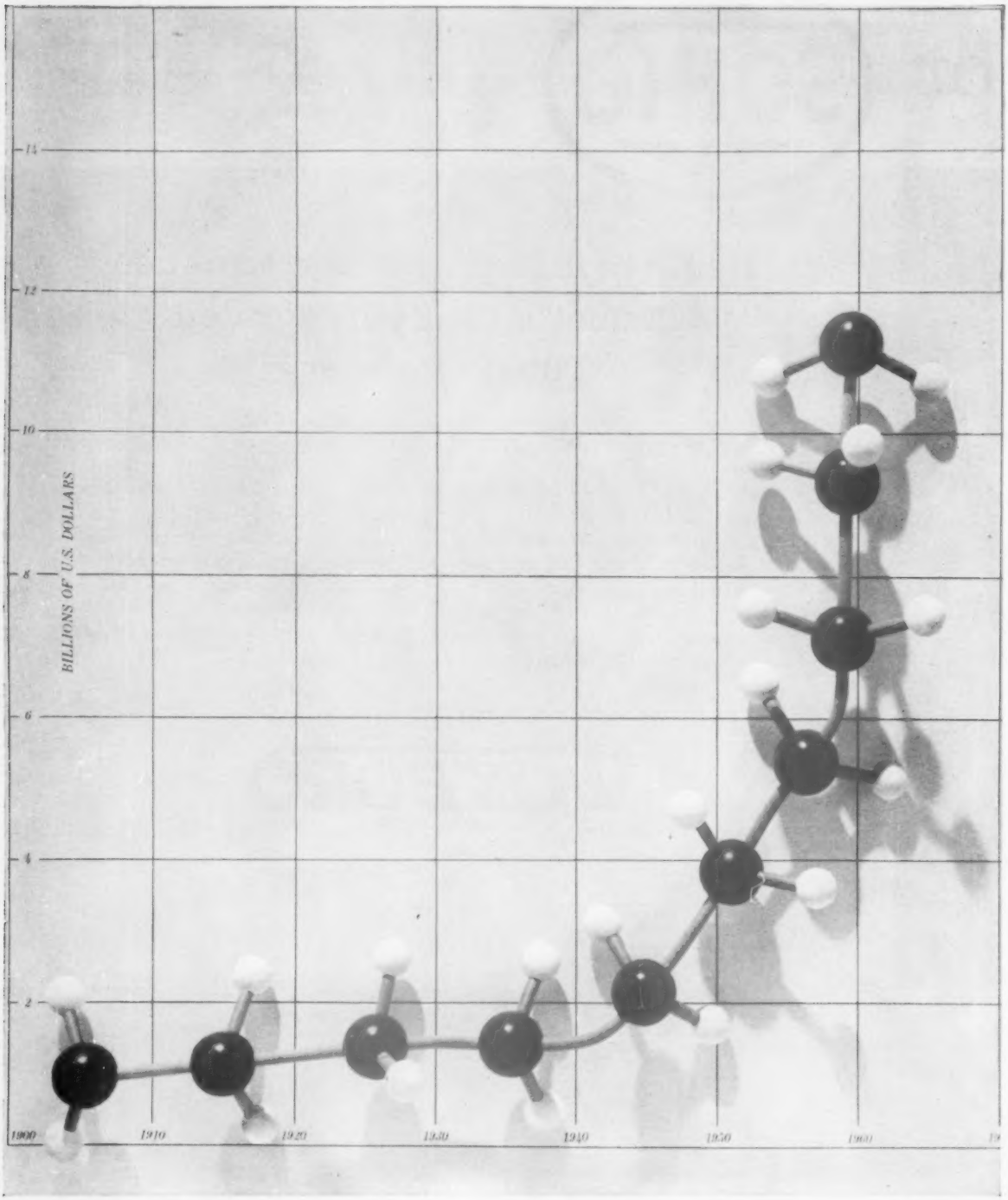
Since intermediate tankage has been eliminated, reliance on instruments approaches 100%. If one unit stops, the whole plant must stop — integration is that complete.

You'll find Foxboro Consotrol* instrumentation on every phase of this bold, cost-cutting refinery design. Accurate, dependable, low-maintenance Consotrols — pneumatic and electronic. The same "reliables" serving refineries the world-over.

If you're not already familiar with the Consotrol story ask your nearby Foxboro field engineer for full details. Or write Foxboro for Bulletin 13-18. The Foxboro Company, 603 Neponset Avenue, Foxboro, Massachusetts. *Reg. U.S. Pat. Off.*

FOXBORO
REG. U.S. PAT. OFF.

†Nerve center at Toledo is this 96-ft. Foxboro-instrumented control panel. Six "satellite" panels handle local control. Since unit must work as one continuous operation—or not at all—reliable instrument performance is essential.



"The upcurve in technology seems to be accelerating. In 1900, industrial research and development was practically non-existent. In 1928, the nation spent less than $100 million for these purposes. Today, expenditures for research and development exceed $10 billion . . . just about double the amount spent only six years ago." —M. J. Rathbone, President

Standard Oil Company (New Jersey)

First... to Last!

The first Columbian Bolted Steel Tanks (and they were the first built anywhere!) were built to last!

Today's Columbian Master-Crafted tanks are built to last, too — even better! They are everything that long-established, careful craftsmanship has always assured — *plus* all that modern research has developed to make them *set up* easier, *fit up* better, *stay tight* longer! You can save both time and money when you need a tank or tanks by getting in touch with your nearest Columbian distributor for the Bolted Steel Tanks that are *Master-Crafted!*

ORDER FROM YOUR NEAREST COLUMBIAN DISTRIBUTOR FOR FASTEST DELIVERY

COLORADO
O'Neill Tank Co.
STERLING

KANSAS
O'Neill Tank Co.
GREAT BEND
HAYS
HILL CITY
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LOUISIANA
McClatchey Tank & Supply Co.
LAFAYETTE
McGuffin Tank Co.
SHREVEPORT

NEBRASKA
O'Neill Tank Co.
KIMBALL

NEW MEXICO
Allied Supply Co.
ARTESIA
American Tank & Steel Co.
FARMINGTON

OKLAHOMA
O'Neill Tank Co.
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TEXAS
B. A. Box Tank & Supply Co.
BEEVILLE
Federal Tank Co., Inc.
BELLAIRE
Martin Tank Co.
CORSICANA
Columbian Steel Tank Co. (Warehouse)
3705 McKinney Ave.
HOUSTON
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KILGORE
Gray-Brown Tank Co.
LONGVIEW
Mapp Tank Co.
ODESSA
Westex Tank Co.
ODESSA

WYOMING
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CANADA
C W S Tank Co.
CALGARY, Alta
EDMONTON, Alta.
ESTEVAN, Sask.

and now...

COLUMBIAN Rigid Frame Steel Buildings

for greatest strength... most usable space!

Columbian Rigid Frame Steel Buildings are Master-crafted — and master-designed to provide maximum work or storage space inside. Whatever the width, length or height you plan, you get greatest unobstructed floor space and overhead clearance.

Use the structural economies and engineered strength of Columbian's basic steel structure for warehouse, field office, storage or tool shed, pump house, garage. Once up, you have a building that is fire-safe, strong and tight, requiring little maintenance, yet can be expanded or moved with ease.

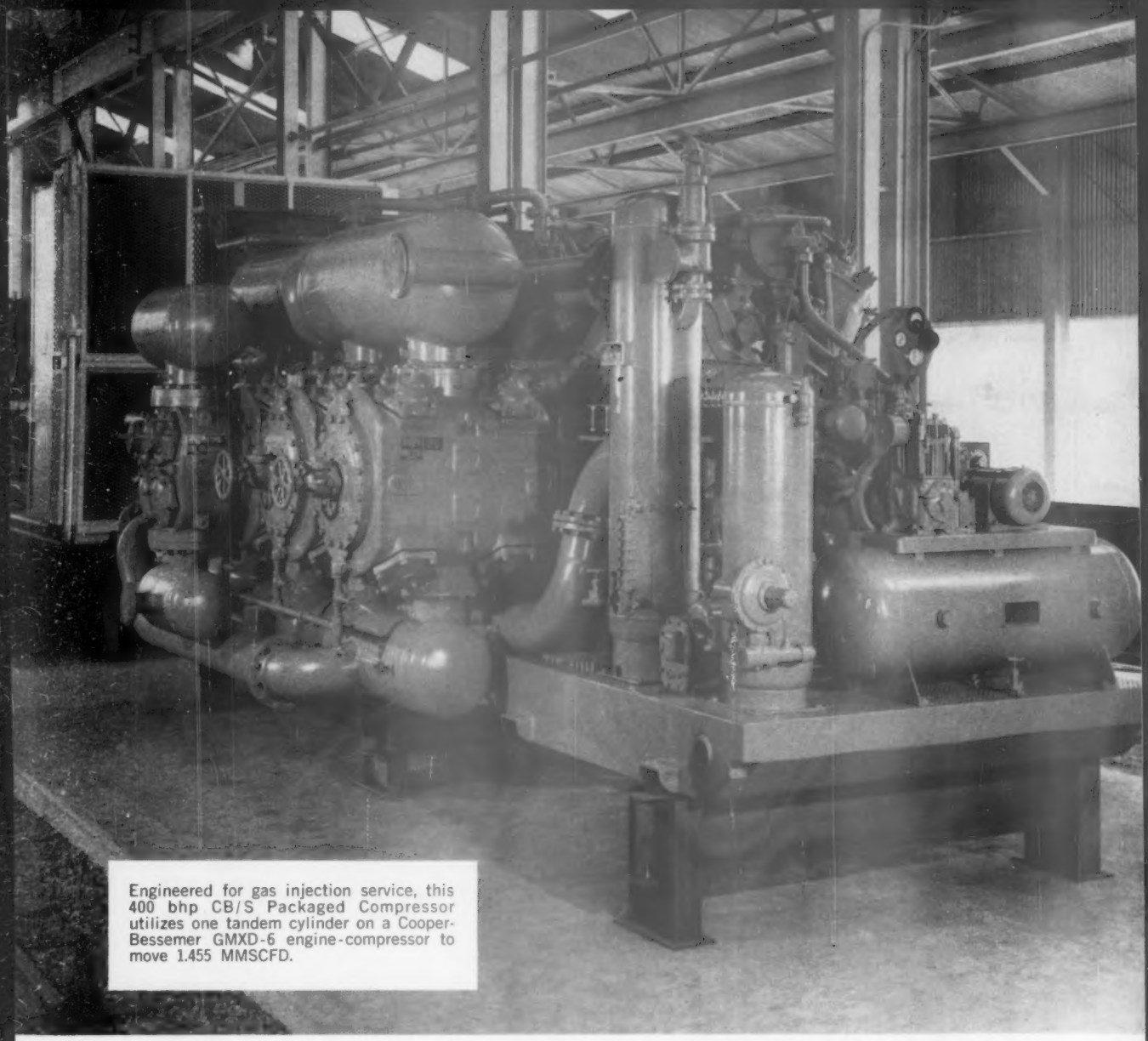
FACTS FREE! Write us today for Steel Tank booklet and Steel Building folder.

COLUMBIAN STEEL TANK CO.
P.O. Box 4048-J Kansas City, Mo.

TANKS FOR THE WORLD

STEEL, Master-Crafted by Columbian... First for Lasting Strength

We do contract steel fabrication



Engineered for gas injection service, this 400 bhp CB/S Packaged Compressor utilizes one tandem cylinder on a Cooper-Bessemer GMXD-6 engine-compressor to move 1.455 MMSCFD.

Building packaged compressors is our business . . . our only business. This single objective is the reason CB/S Packaged Compressors are more advanced in design . . . more efficient in the field.

CB/S
PACKAGED
COMPRESSORS

CB/S

C-B SOUTHERN, INC., P. O. BOX 19267, HOUSTON 24, TEXAS

A subsidiary of The Cooper-Bessemer Corporation.

"We deliver too"

What's so special about the huge fractionating tower shown here? It is one more example of how Sun Ship builds and delivers heavy industrial equipment on barges or sea-going vessels, with careful attention to such requirements as safety and on-time schedule.

Whether it's a fractionating tower or key structural part for industry, transporting big items by water or by rail is strictly routine for Sun Ship, for we build and deliver what's needed in many fields. If you have a machinery or heavy equipment problem, write to us about it.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • SINCE 1916 • CHESTER, PA.

ARMOUR FUEL OIL ADDITIVES –

How they protect against sludge from refinery to furnace

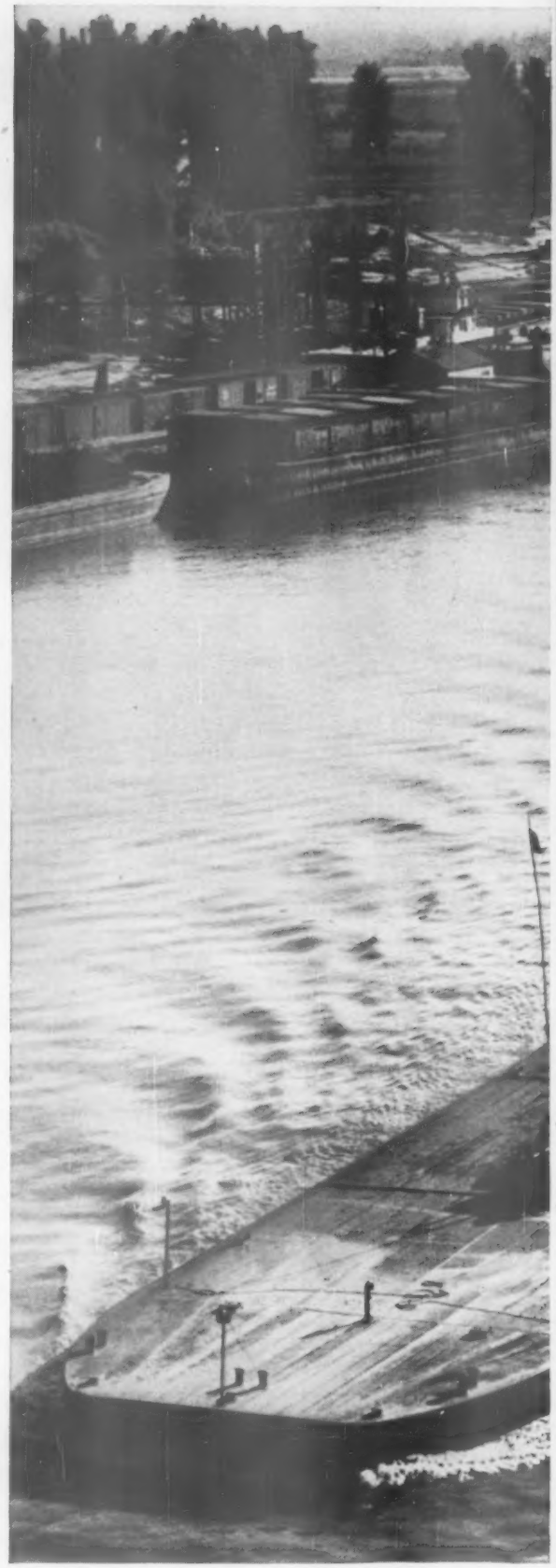
Armolad® additives, Armour's furnace-oil stabilizers, are gaining wide acceptance as highly economical and effective sludge inhibitors. Using Armolads, refiners can stop worrying about additives that lose effectiveness while in transit or storage.

Fuel oil additives are subject to various conditions which can reduce their sludge-inhibiting properties. Major causes are: incompatibility with other additives, reaction with fuel contaminants themselves, and the presence of water—particularly in barges and storage tanks—which causes "leaching." Maintaining the effectiveness of the additive can only be achieved by increasing the concentration, which in turn raises costs unnecessarily.

Refiners using Armolads have found they are extremely resistant to water extraction, compatible with most other additives, help eliminate hazing, and will not react with fuel contaminants.

In addition, when fuel oil containing Armolads is pumped through the lines, monomolecular adsorption places a thin coating of the additive on the surfaces. This film offers resistance to corrosive action.

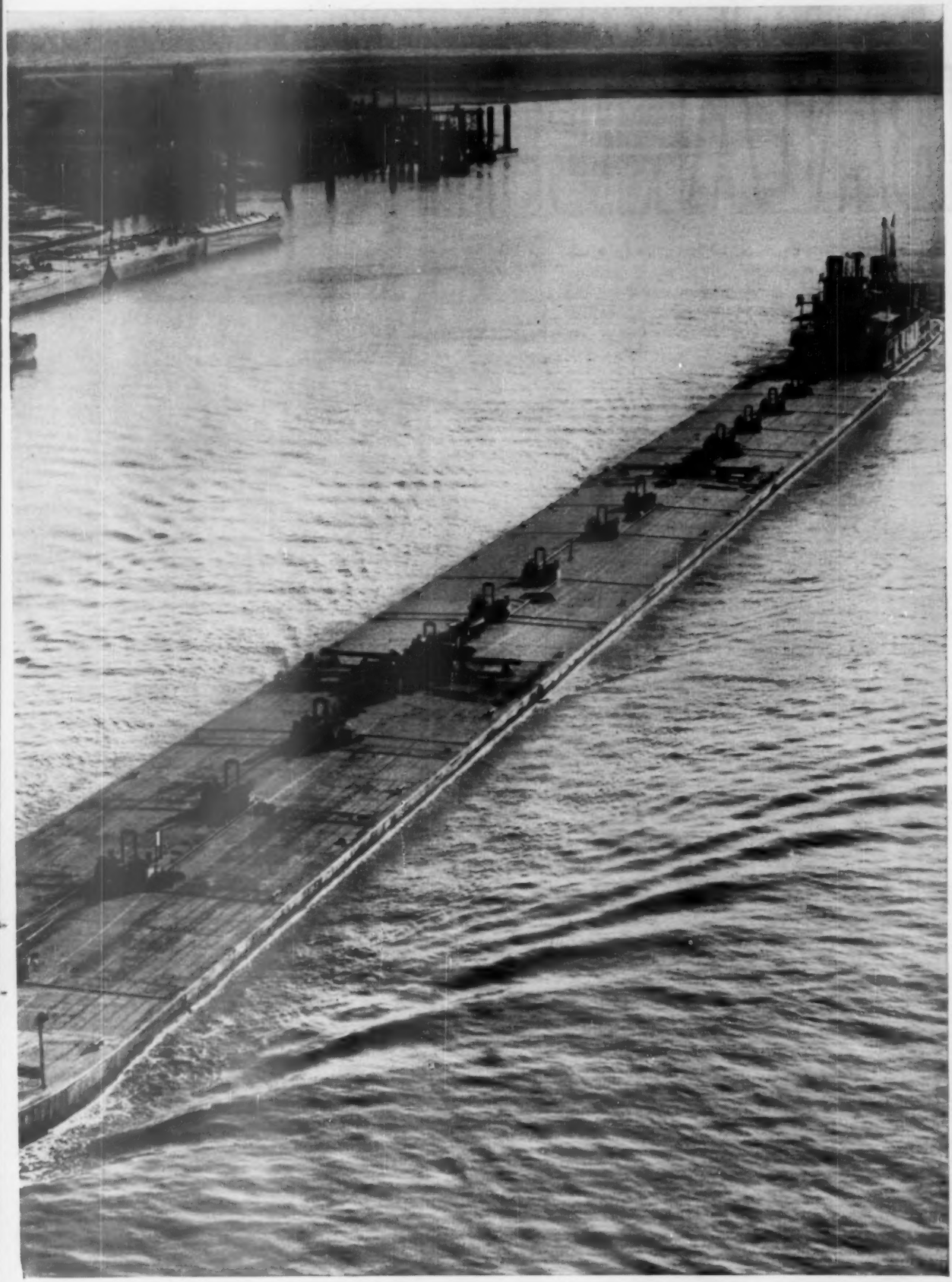
Armolads are available in several different formulations. Each has been found to suit the special needs of specific crude stocks. Additional information on these additives and their use is available by writing for the new booklet "Armolads."



Armour Industrial Chemical Company

© Division of Armour and Company

110 NORH WACKER DRIVE • CHICAGO 6, ILLINOIS

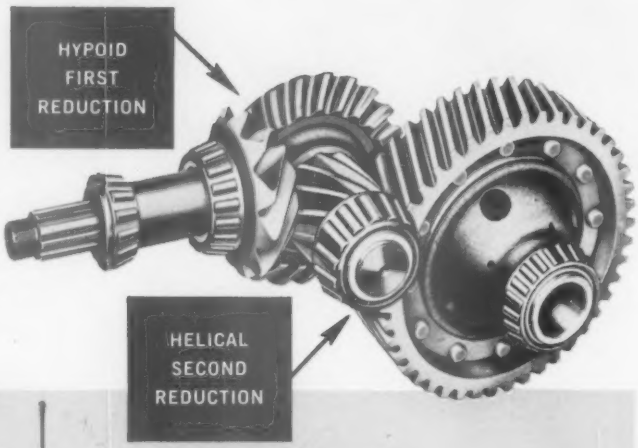


Heavy-Duty Hauling Jobs Are Easy With Timken-Detroit®

BALANCED

HYPOID-HELICAL DOUBLE-REDUCTION AXLES

Timken-Detroit balanced hypoid-helical double-reduction gearing is unequalled for top performance and dependability. Outstanding advantages that make it the choice of heavy-duty equipment manufacturers and operators are: big, husky gears . . . greater flexibility in gear ratios . . . balanced gear set loadings . . . long life and low maintenance costs. The hypoid first reduction is 30% stronger than spiral bevel, and works in series with the second reduction to take an equal share of the load. In the helical second reduction, strong helical gears with a wide range of ratios insure balanced double-reduction gearing.



240 SERIES

SINGLE-SPEED, HYPOID-HELICAL DOUBLE-REDUCTION

Two full-sized gear sets form a balanced power train—with each gear set accomplishing a substantial reduction. This combination of husky hypoid first reduction gears coupled with rugged, wide-faced helical second reduction gears provides a double-reduction gear set that outperforms all others. Because the ratios of each reduction may be varied, you get a balanced power train with the larger selection of axle ratios for maximum operational versatility and performance.

340 SERIES

TWO-SPEED, HYPOID-HELICAL DOUBLE-REDUCTION

A true two-speed axle which provides two separate gear ratios through the use of two full-size helical gear sets . . . a "fast" ratio for maximum speeds and a "slow" ratio for greatest pulling power. Pick the most efficient gear ratio to meet your requirements of speed, load and road. Spring-flex power shifting provides simple, positive shifting with either air, vacuum or electric actuation. Timken-Detroit two-speed hypoid-helical double-reduction axles give a versatility and economy to trucking operations that is unmatched by other axle gear designs.

choice of two—

INTERCHANGEABLE BALANCED DOUBLE-REDUCTION DRIVES

Another Product of...

ROCKWELL-STANDARD CORPORATION

ROCKWELL R STANDARD

Transmission and Axle Division, Detroit 32, Michigan

From Davison Catalysts

more high octane gasoline . . . and higher octane numbers . . . are produced by Davison Catalysts than any other in the world.

When it is realized that Davison Catalysts give more barrels of gasoline per pound of catalyst . . . more gasoline per pound of coke . . . higher stability and better stripping, plus higher attrition resistance . . . and more alkylation feed, *then* you know the reason why more refiners say "Davison" for gasoline cracking.

Too, it costs less to use Davison Catalysts. Experience reveals lower stack losses, greater heat and steam resistance, lower catalyst inventories. Call or write today for the most practical answer to your catalyst needs.

W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
BALTIMORE 3, MARYLAND
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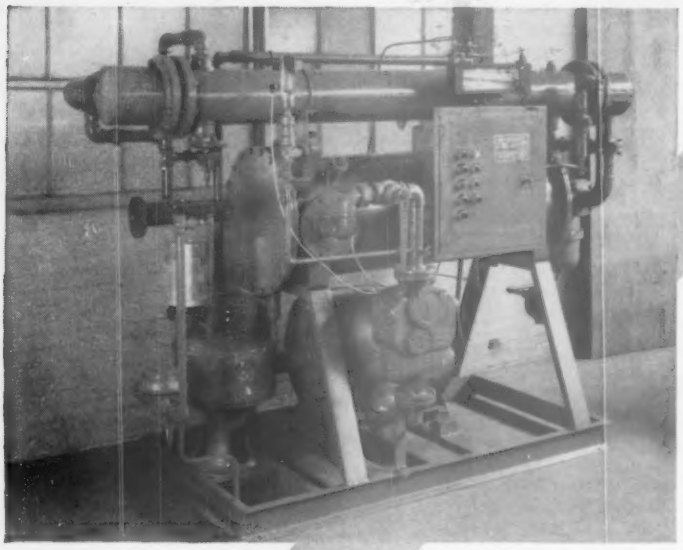
KEMP INERT GAS GENERATORS

give you 4 basic advantages!



FOR BLANKETING
AGITATING
O_2 EXCLUSION
PURGING
FIRE AND
EXPLOSION
ATMOSPHERES

1 **Constant analysis** is automatic due to the exclusive Kemp Carburetor that pre-mixes gas and air in precisely the ratio you desire . . . maintains it regardless of total demand or pressure fluctuation in the supply line.

2 **Easy start-up** is yours with Kemp Carburetor and external test burner. You test the pre-mixed gas-air ratio *before* it enters the combustion chamber. And electric ignition gets your Kemp Generator off to a time-saving, labor-saving start.

3 **Safety controls** effectively end flame-out danger. Kemp's electronic flame failure control instantly and automatically cuts off gas supply to the carburetor. Moisture and combustion chamber pressure cannot affect this control.

4 **Set it—forget it.** Once you've set the vernier dial on your Kemp Generator you can walk away and forget about it. Kemp's exclusive carburetor keeps your exact gas-air ratio coming hour after hour—as long as you wish—without further checking or manipulation of controls.

SEE THE MAN FROM KEMP

He is equipped and qualified to advise you on any size and type of generator you may require . . . can also counsel you on dryers and compressors for inert or nitrogen generation systems and heaters. See your C.E.C. Catalog for full listing of Kemp representatives in your area or check your local telephone book. For details on Kemp Inert Gas Generators, write for Bulletin I-10.

It always pays to come to

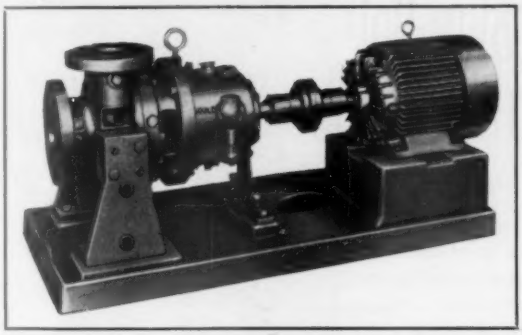
KEMP
OF BALTIMORE

THE C. M. KEMP MANUFACTURING COMPANY
405 E. Oliver St., Baltimore 2, Md.

THIS IS INTERMEDIATE-RANGE DESIGN

Robert Fornesi, Senior Application Engineer, Goulds Pumps, Inc.

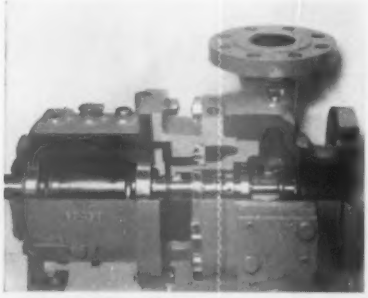
Changing requirements created this third dimension in process pump selection



Once upon a time you had to meet petroleum process applications with pumps in only these two ranges: (1) Light duty pumps to handle temperatures up to 200° or at most 300°. (2) Real heavy duty pumps for 200° to 800°. That's changed.

Here's why. Goulds product development group appraised the growing range requirements and services of petroleum process pumps. They found that 200° was no longer a realistic dividing line for process pump types. The need was for one pump which would handle all light duty applications and the growing number of intermediate applications as well.

Why should you have to buy a light duty pump with built-in temperature limitations when an intermediate-range pump could be built for almost the same price? Why should you pay for an 800° heavy duty pump to handle all the applications above 200° or 300°?



THIS DESIGN SOLVES HIGH TEMPERATURE SEAL PROBLEMS

Goulds designers felt they had the answer to both these questions in their plans for the Model 3775 line. This was not enough.

The design concept was verified by field research. The plans were rolled up from the drawing board and flown and shown all over the country. Plant superintendents and operating engineers saw them. They said yes.

They liked the rather obvious ideas that made INTERMEDIATE DESIGN POSSIBLE . . . the mechanical seal isolated in a seal chamber. This to allow for cooling of the liquid within the seal chamber. It made higher temperature handling with mechanical seals possible as it protected the seal. In similarly priced pumps the mechanical seal area behind the impeller is wide open. The hot pumpage is in constant contact with the seal. With the Model 3775 seals are not exposed to direct contact with hot pumpage. Cooler seals mean longer seal life.

COOLED CASING SUPPORT . . . A PLUS FEATURE

This was not enough. To be completely fit for INTERMEDIATE-RANGE (up to 650°) applications the Model 3775 had to have these features of costlier heavy duty pumps—cooled bearings and casing support.

Goulds Model 3775 has them all—water-cooled bearing housing and casing support as well as the seal chamber. This plus the choice of either internal or external flushing of the seal chamber. Single, double, balanced or unbalanced seals available to properly fit the application.

The pump is back pull-out type for easy maintenance. A spacer coupling allows you to remove the rotating parts without disturbing pipe connections or driver.

Built in accordance with API 610 specs, the fine mechanical features of this pump provide a husky line of pumps with maximum standardization and interchangeability of parts. Eleven sizes are built on the same bearing frame.

The Model 3775 is a horizontal center line mount with vertically split casings. Renewable casing wearing rings maintain proper clearance with impeller wearing rings. Leakage between suction and discharge chambers of the casing can be held to an absolute minimum.

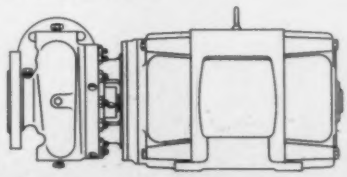
Talk over your process handling methods and problems with your Goulds engineer. He'll show you many more reasons why the INTERMEDIATE-RANGE 3775 is your best process pump choice for the majority of applications . . . *why it makes light duty pumps obsolete.* How it better fits the growing range of your process requirements.

AND AT LAST . . . A CLOSE-COUPLED PROCESS PUMP!

Goulds Model 3675 is the close-coupled version of the 3775. These units use the same liquid end as the frame mounts. The 3675 casing may be swiveled to four different discharge positions.

This integral pump-motor design provides the maximum in economy and compactness. Flexibility, too! One of our customers changed a process. A steel-case pump was required. Buy all new units? No, Goulds Model 3675 liquid ends fitted on the customer's present motors and provided the same rating. Only the casing was changed.

Get the complete story on these new pumps and all the others in the modern Goulds line. Send our factory the coupon below.



GOULDS PUMPS

GOULDS PUMPS, INC. Dept. 06J-30, Seneca Falls, N.Y., U.S.A.

Send me a bulletin with complete application data on your INTERMEDIATE-RANGE DESIGN petroleum process pump.

Anything else? Please check.

- ☐ 1-stage centrifugal—Model 3405
- ☐ 2-stage centrifugal—Model 3305
- ☐ Steel case Pumps Bulletin

NAME _____ DEPT. OR TITLE _____

COMPANY _____ ADDRESS _____

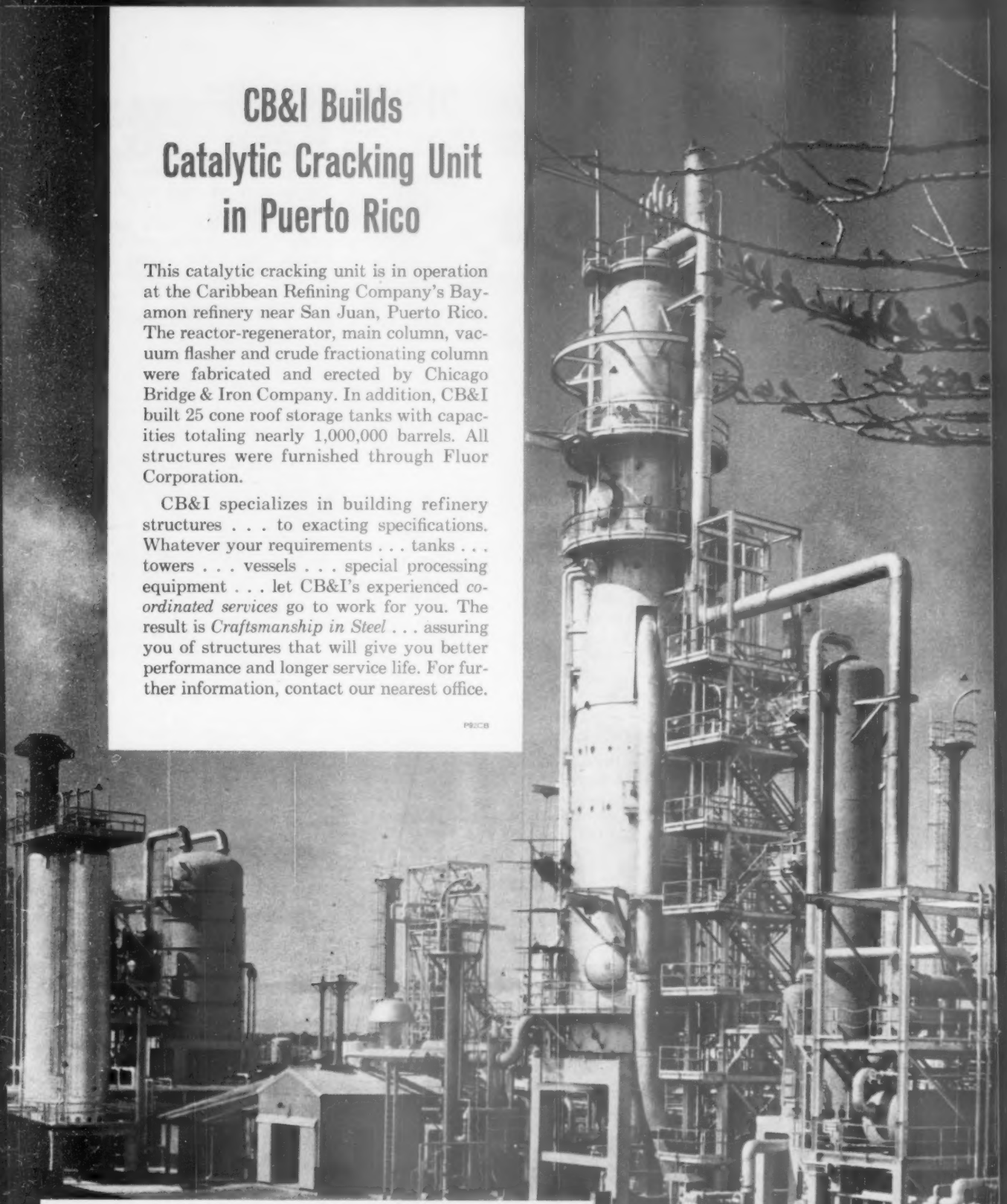
CITY _____ ZONE _____ STATE _____

CB&I Builds Catalytic Cracking Unit in Puerto Rico

This catalytic cracking unit is in operation at the Caribbean Refining Company's Bayamon refinery near San Juan, Puerto Rico. The reactor-regenerator, main column, vacuum flasher and crude fractionating column were fabricated and erected by Chicago Bridge & Iron Company. In addition, CB&I built 25 cone roof storage tanks with capacities totaling nearly 1,000,000 barrels. All structures were furnished through Fluor Corporation.

CB&I specializes in building refinery structures . . . to exacting specifications. Whatever your requirements . . . tanks . . . towers . . . vessels . . . special processing equipment . . . let CB&I's experienced *coordinated services* go to work for you. The result is *Craftsmanship in Steel* . . . assuring you of structures that will give you better performance and longer service life. For further information, contact our nearest office.

P92CB



CHICAGO BRIDGE & IRON COMPANY

332 SOUTH MICHIGAN AVENUE
CHICAGO 4, ILLINOIS

OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

Know it by the yellow handle

Use it because it embodies features never before combined in a needle throttling valve . . .

It is the first throttling and shut off valve that serves the whole range of pressures—from low to 10,000 psi—with equal efficiency all the way through.

It is the valve in which body and stem guide are one piece—completely fused into an integral leak-proof unit by the exclusive Marsh "Conoweld" process.

It is the valve in which the stem is precision machined and ground. Perfect stem alignment and fine threads provide easy and precise throttling. Special "Marpak" packing always holds tight; never binds.

Bodies of the 1900 series identified by the yellow handle are machined from high grade carbon steel bar stock marked in accordance with M.S.S. regulations showing size, material and service. Stems are 416 stainless steel. Valves are available in the patterns shown below; sizes ⅛", ¼", ⅜", ½", ¾" and 1".

Marsh Needle Valves are also available in 416 stainless steel throughout (identified by green handles). *Write for bulletins.*

MARSH INSTRUMENT COMPANY, Dept. L, Skokie, Ill.
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas

In stock at your nearest Supply House

Conventional Construction

Marsh Construction

In conventional valve (left) stem-guide is threaded into body . . . can be backed out when valve is fully opened, causing real trouble when pressure is high. Can't happen with Marsh design (right). Marsh stem-guide is welded to body.

MARSH

SERIES 1900

Needle Valves

Crossing the ice bridge near Fort McMurray, the first of nine plant sections—each on self-contained runners—starts the 35-mile "skid" to the site.

KELLOGG ENGINEERS PLANTS TO

GET THERE ON TIME

A Kellogg characteristic that pays off for clients is getting plants on stream on time. For Cities Service' tar sands project in Northern Alberta, this meant not only designing and building a small diluent recovery and visbreaking plant off-site in record time but shipping it 300 miles by rail, then 35 miles by sled.

Lacking highways, railroads, docks, the site can be reached with heavy equipment only in winter by sled. Once the thaw starts, March 15, tractors bog down, wheeled vehicles are useless, the nearby river—lacking bridges—is impassable. With March 15 as the absolute deadline for delivery, Kellogg started a crash program when given the assignment in November.

Avoidingconventionaldrawings,Kellogg engineered and designed the pilot plant on a scale model, completed it by December 15, shipped it to fabricators in Edmonton as sole reference in building to full size. Meanwhile, as early as November 1, The Canadian Kellogg Company in Toronto had commenced procurement of basic materials and equipment.

By December 15, preliminary fabrication steps were well under way at Edmonton. Auxiliary equipment was beginning to arrive on order from Canadian Kellogg. Necessary subcontracts had been let in Edmonton, and work carefully coordinated.

Before the end of January, the first complete section of the plant had been dispatched to Fort McMurray. By the first week in March, all sections had been sleighed from this railhead to the plant site. To facilitate this last 35-mile trip, each section was designed so that its structural steel could be used as runners.

Executives planning additional oil refining units or petrochemical plants are invited to learn more about Kellogg's coordinated engineering-procurement-construction services and how they can speed the completion of new facilities.

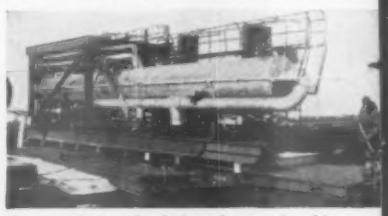
THE M. W. KELLOGG COMPANY

711 Third Avenue, New York 17, N. Y.

A Subsidiary of Pullman Incorporated

Offices of Kellogg subsidiary companies are in Toronto, London, Paris, Buenos Aires, Rio de Janeiro, Caracas

Kellogg engineers in New York examine model of plant, used in building to full size, before shipping to fabricators in Edmonton.



Section of plant loaded on flat car for shipment to Fort McMurray, nearest railhead, and from there for sleighing to the plant site.

Section of plant on way to site. Premature melting of snow in places required dragging of unit on dirt roads. Note integral runners.

sharp

AMERICAN BI-METAL THERMOMETERS make
accurate temperature readings sharp and sure at all check points

American Dial Thermometers are also available in mercury, vapor pressure, and gas actuation . . . on-the-spot and distant reading types . . . in sizes, ranges and stem lengths to meet your most exacting requirements.

sensitive

Any way you look at an American Bi-Metal Thermometer, you see exact working temperatures.

The two-level "Maxivision®" dial eliminates parallax effects. Numerals are on the lower level. Graduations are on the outer raised ring dial which presents a sheared edge to the tip of the pointer and in the same plane. To make readability even more accurate, the glass and graduated dial are closely spaced.

American Bi-Metal Thermometers are made of weather-proof stainless steel. All joints are welded to solid unity, then polished smooth so corrosion won't build up and destroy the thermometer's usefulness. And, you don't have to discard this thermometer even if the glass is ever broken. The bayonet lock bezel makes replacement easy.

Learn about the high sustained accuracy and long service life built into American Bi-Metal Thermometers. Phone your nearby industrial supply distributor for help in selecting the right type for each temperature check point in your plant. Or write for Catalog 100A.

MANNING MAXWELL & MOORE INC. MM&M TRADE MARK

AMERICAN INDUSTRIAL THERMOMETERS
A product of
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CYANAMID INTRODUCES A NEW FLUID CRACKING CATALYST COMPOSITION—

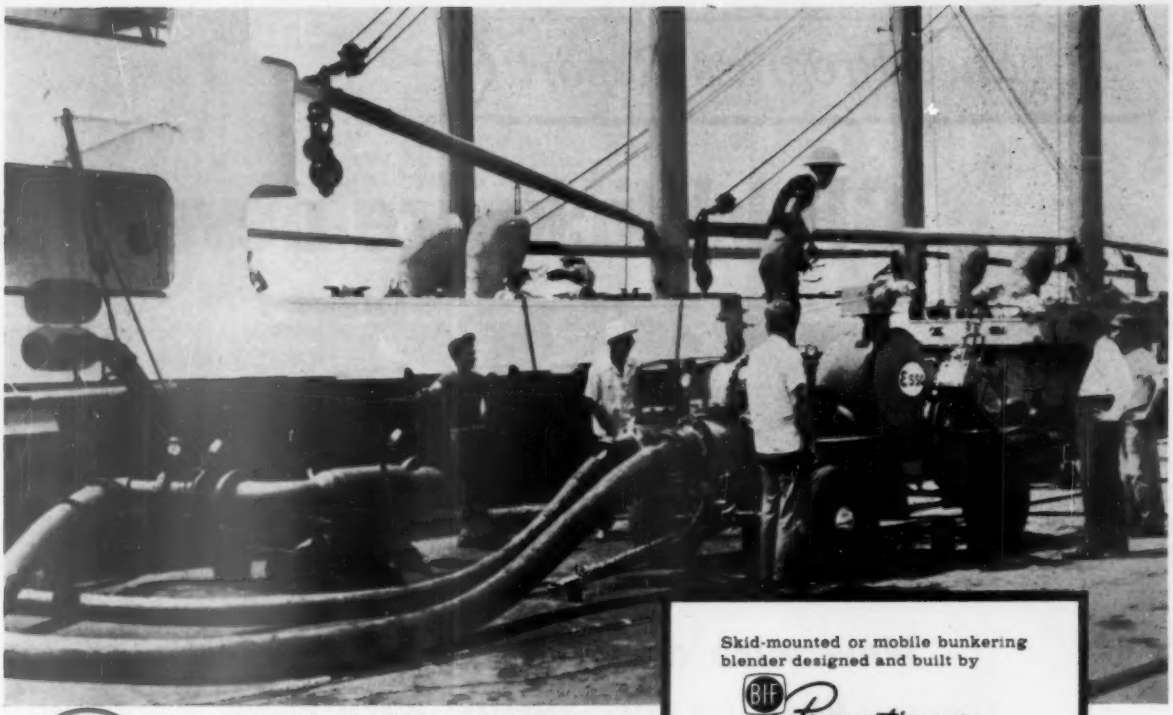
AEROCAT® 3C

Cyanamid, in cooperation with a major oil company, has developed AEROCAT® 3C—a new fluid cracking catalyst composition. Designed to provide refiners with more flexible and profitable refinery operations, AEROCAT 3C yields more gasoline, more propylenes and butylenes at the expense of dry gas and coke. AEROCAT 3C–12 for increased gasoline yield. AEROCAT 3C–20 for increased propylene and butylene yields.

BASIC IN CATALYST CHEMISTRY

CYANAMID

AMERICAN CYANAMID COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, N. Y., 20, N. Y.



Everywhere—BRODIE is linked with Progress.
Here's another example from Cristobal, Canal Zone.

BUNKERING/BLENDING

with BRODIE

BiRotor METERS

B.I.F Proportioneers, leading engineering designers and builders of systems and equipment for positive control of petroleum products, rely on dependable Brodie *BiRotor* Meters for many of their unique, custom-built installations. Whether it's a versatile mobile bunkering blender, pipeline, refinery or marketing application, Brodie *BiRotor* Meters are noted for high sustained accuracy and low maintenance.

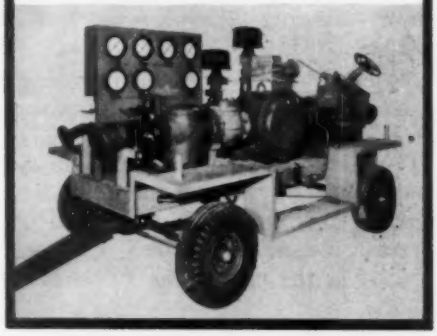
In every bulk transfer operation – from wellhead to truck-tank delivery–you never have to "baby" a Brodie *BiRotor* Meter. It's safe to operate at full rated capacity. Whatever your metering need, call your nearby Brodie Metering Specialist!

912

Skid-mounted or mobile bunkering blender designed and built by

BIF Proportioneers

utilizing Brodie *BiRotor* Meters. Compact unit provides positive control at dockside for fast accurate bunkering of ships.



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BRODIE
BiRotor METERS

REPRESENTATIVES WITH STOCKS AND SERVICE FACILITIES IN ALL PRINCIPAL CITIES

Advance Progress Report

CF&I-Wickwire develops DOUBLE

New wire drawing technique gives you longer-lasting wire rope

CF&I-Wickwire's premium wire rope – Double Gray – has now been improved by a remarkable new wire drawing technique. This new wire rope – Double Gray-X – provides EXTRA LONG LIFE.

Wickwire's advanced wire drawing process is the joint effort of our research engineers, metallurgists and key production people. They sought to reduce the friction between the wires within the rope itself, thus producing a wire rope with greater resistance to bending fatigue. An important step in Wickwire's new wire drawing process is the use of *molybdenum disulphide.*

"Moly Disulphide" builds a thin, permanent molecular shield around each wire. Coupled with Wickwire's other advanced wire processing techniques, it gives these results:

- *Friction-free interaction of the individual wires in every strand of Double Gray-X* – A molecular jacket of Moly Disulphide on each wire helps cushion them against the effects of bending, crushing and abrasion. As the rope operates over sheaves, for example, the molecular shield tends to prevent the wire surfaces from grinding against each other, reducing friction and wear.

a superior wire rope

GRAY-X

- *Smoother surface to the wires*—In any wire, tiny imperfections occasionally form on the surface. These "weak links" can cause premature breaking of the wires and impair the life of the rope. Moly Disulphide helps eliminate any minute nicks, creating smoother-surfaced wires.
- *Higher degree of toughness which is essential to longer wire rope life*—Moly Disulphide greatly minimizes the friction involved in the drawing operation, thus preventing the wires from "heating up". This assures the correct physical properties for every wire in Double Gray-X and helps the wire retain its original toughness.

Double Gray-X will be made in a wide range of sizes and constructions to give greater operating economy and reduced downtime for all types of rope-using equipment. It will be available soon from CF&I-Wickwire's chain of warehouses and through a network of nationwide distributors.

EXTRA STRENGTH

In addition to longer life, Double Gray-X gives you the extra strength of Double Gray Wire Rope. Made of extra improved plow steel with an Independent Wire Rope Core, this rope gives 15% higher breaking strength than the catalog breaking strength of an improved plow steel rope with IWRC.

7484

WICKWIRE ROPE

THE COLORADO FUEL AND IRON CORPORATION

CF&I STEEL

In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso Farmington (N. M.) • Ft. Worth • Houston • Kansas City • Lincoln • Los Angeles • Oakland • Odessa (Tex.) • Oklahoma City Phoenix • Portland • Pueblo • Salt Lake City • San Francisco • San Leandro • Seattle • Spokane • Tulsa • Wichita
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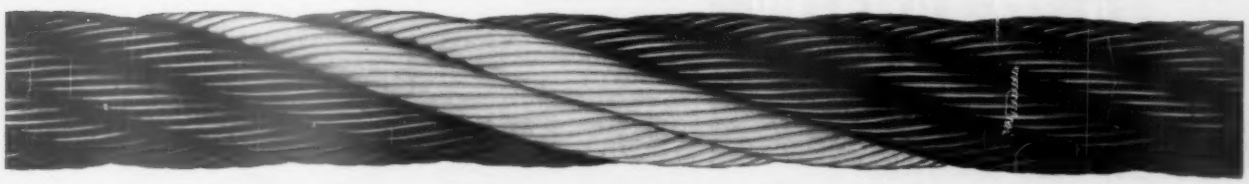
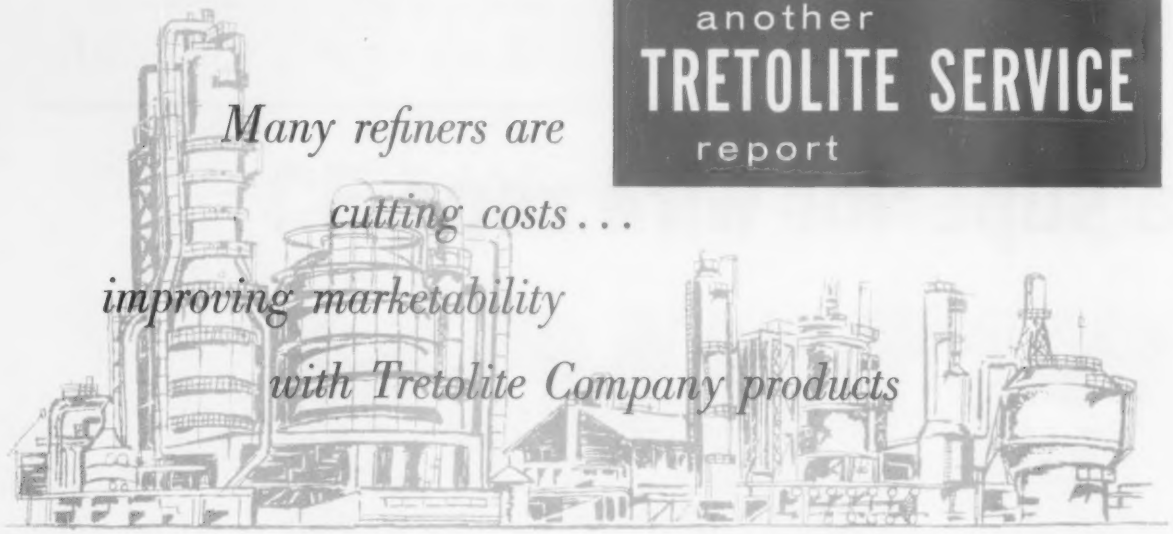


another
TRETOLITE SERVICE
report



Many refiners are cutting costs . . . improving marketability with Tretolite Company products

TRET-O-LITE* *Demulsifiers*

TRET-O-LITE demulsifying chemicals were developed and pioneered to enable producers to reclaim profitably otherwise unmarketable emulsified crudes. Refiners also use TRET-O-LITE emulsion-breakers to salvage usable oil trapped in "tank-bottoms", thereby gaining valuable storage capacity lost when tank-bottoms accumulate. TRET-O-LITE demulsifying chemicals are effectively used to reclaim usable oils from refinery waste disposal systems and separator traps.

If oil and water emulsification is causing an operating problem in your refinery, call Tretolite.

TRET-O-LITE* *Desalting Chemicals*

The Tretolite Company pioneered the use of chemicals in crude oil desalting, and developed the first desalting system in which chemicals provided emulsion destabilizing action.

Refiners all over the world now rely on TRET-O-LITE for efficient, economical desalting performance.

TRET-O-LITE Desalting Chemicals also are widely used in chemical-electric desalting, as well as chemical aid to electric desalting when certain adverse treating conditions are encountered.

Ask your Tretolite Refinery Service Engineer about the economy of TRET-O-LITE *Desalting Chemicals.*

KONTOL* *Corrosion Inhibitors*

KONTOL Corrosion Inhibitors are liquid organic semi-polar compounds available in a variety of formulas. They adsorb at metal surfaces to form an impervious corrosion-inhibiting film. KONTOL Corrosion Inhibitors prevent corrosion in refinery equipment by protecting against attack by chlorides, sulfides, organic acids and hydrogen blistering. They are effective detergents and provide an economical means for maintaining cleanliness and heat transfer efficiency in condensers and exchangers.

KONTOL *Corrosion Inhibitors have been cutting maintenance costs for refiners for many years. Complete information is yours on request.*

TOLAD* *Fuel Additives*

TOLAD Fuel Additives are ashless, totally oil-soluble compounds. They stabilize color in heating oils and diesel fuels. They effectively disperse the insoluble solids which form sludge and impair burning qualities.

TOLAD additives have excellent water tolerance characteristics which prevent loss to water bottoms in fuel storage. They are available as inhibitor or inhibitor-dispersant formulations. TOLAD is approved, and used, by leading railroads.

Get all the facts on this new Tretolite product. In test after test, TOLAD *has provided better fuel stability at lower cost. Why not prove this to your own satisfaction—and profit.*

For complete information on these, or any Tretolite Company product or service, ask the Man in the Red Car, or write

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for those HIGH LIFTS *around Refinery or Rig!*

Perhaps nowhere is delicacy of control more important than in crane operation around a refinery or a drill rig.

Northwest brings you five mighty workhorses to choose from particularly equipped and suited to crane lifting problems in oilfield locations. From the 25-D to the big Northwest Model 95, you have a range from 13-ton to 60-ton capacity. Here is crane equipment that brings smoothness of performance in handling high lifts and long booms.

The Feather-Touch Clutch Control gives you the *true* feel of the load that assures accuracy for spotting a valve, holding a pipe for coupling, or the gentleness needed for setting a heavy load.

Northwest Uniform Pressure Swing Clutches are big, cool running and give you smooth engagement. They bring you freedom from the grabs and jerks that set a boom to jumping. With a Northwest you put a load where you want it without jockeying.

Northwest Boom Hoists meet any booming problem. The Northwest High Speed Boom Hoists are independent of all other machine functions and operate under power both up and down. If you need a third load line, a third drum is available.

Northwest Cranes bring you every advantage you need for crane work: Sectional Boom Hoist Rigging and Pendant Lines, Telescopic Boom Struts, Folding Gantries, Adjustable Jibs, Open-Throat Booms, Removable Counterweight, and a host of other advantages are either standard or available.

You will be interested in what Northwest has for you. Get the full story on the size machine you need before buying a crane.

CRANES
SHOVELS
DRAGLINES
PULLSHOVELS
TRUCK CRANES

3/4 to 3 Cu. Yd. Capacity

NORTHWEST

NORTHWEST ENGINEERING CO.
1513 Field Building, 135 South La Salle Street, Chicago 3, Illinois

C-95-21-L

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

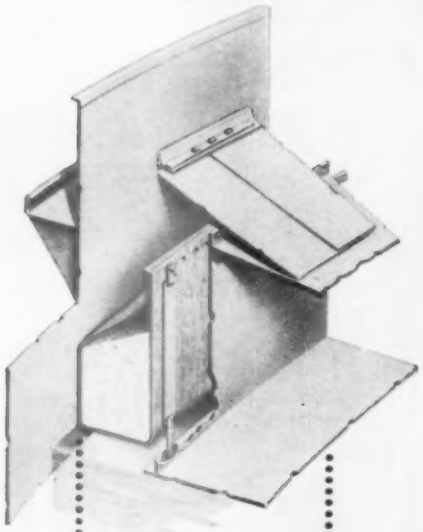
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.

FIRST solid cushion seal



When General American developed EverSeal, first solid cushion seal for floating roofs, we wanted a seal that would have these advantages:

1. Simplicity of design, no moving parts, nothing to corrode
2. Permanent, indestructible sealing qualities—no gas or liquid to leak
3. Complete protection of coated tank walls from scuffing or gouging
4. A tough, pliable envelope that would withstand abrasion; ride without damage over projections on the shell
5. Ease of repair or replacement, without taking tank out of service
6. Maximum protection against evaporation loss
7. Full protection of oxygen-sensitive stocks
8. No build-up of vapors in the seal area

EverSeal is the *first* solid cushion seal to meet *all* these requirements. It is made of trapezoidal urethane foam cushions enclosed in a tough, scuff-proof envelope of Buna "N" synthetic rubber and polyvinyl chloride plastic.

EverSeal is almost impossible to damage, always provides a safe and complete seal for every floating roof.

Write or phone your nearest General American office for complete information.

It pays to plan with General American.

EverSeal*

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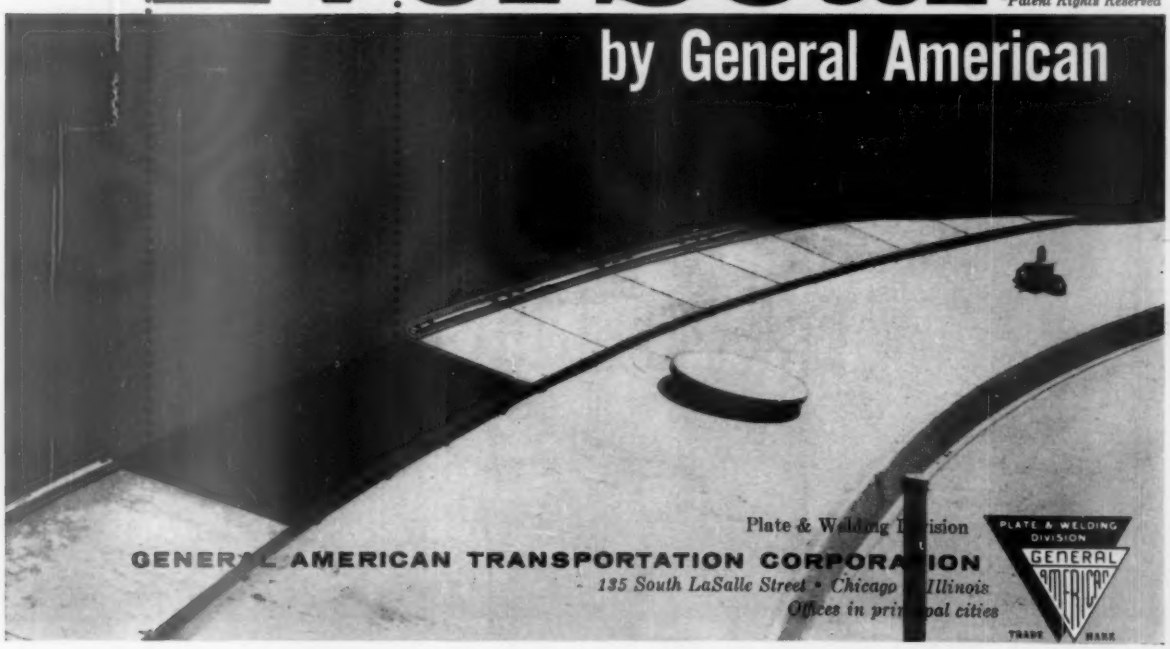

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THE NAME TO WATCH IN PRODUCTION VALVES

GROVE

From thousands of proven Grove Seal-O-Ring valve installations to the new Grove Valv-Pak complete well-head flow manifold — the name Grove stands for dependability. For no other valve serving the oil field offers the exclusive Grove Protected Seal-O-Ring feature for positive, bubble-tight seal. The big plus feature of no lubrication ever makes Grove production valves your best buy. **Watch Grove go in new ideas for production valves!**

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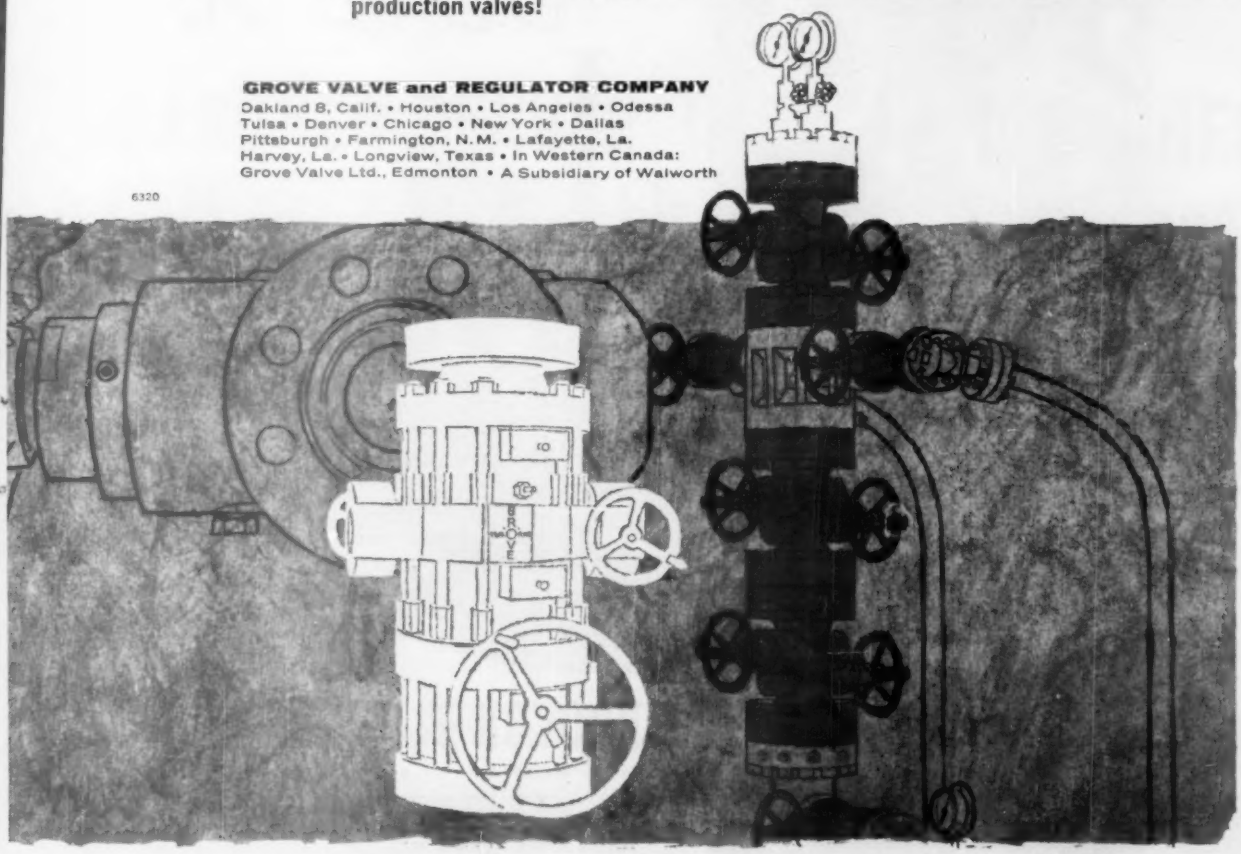

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It's a long road from blueprint and flow chart to efficient plant performance. It takes an intimate knowledge of the route to assure safe and timely arrival.

To show where you're headed before you start, Procon presents an accurate picture of what will be provided for every penny invested.

Regardless of where or what the client plans to build . . . petroleum, petrochemical or chemical process facilities . . . Procon prepares a firm proposal covering every detail of construction.

Before planning new construction, consult Procon. It pays . . . in superior construction and assured plant performance.

*A SUBSTANTIAL INCREASE IN PROCESS CAPACITY will be needed by 1962, according to reliable estimates . . . NOW is the time to start your planning!

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AVAILABLE IN ¾" AND 1¼" CAPACITIES. Shown at right is Model 18-B-7 with ¾" rated capacity. Write for Bulletin 18-11.

NEW

GARDNER-DENVER IMPACT WRENCHES hit harder...last longer

Model 18-B-9 impact wrench with 1¼" rated capacity. Write for Bulletin 18-15.

Here are two new lightweight, easy-to-use impact wrenches that hit harder—yet don't wear themselves out. They're the result of intensive Gardner-Denver engineering to develop a powerful, long-lasting impact mechanism. The combination of a fast-accelerating air motor and a new, patented clutch mechanism assures positive starts, efficient impacting and lowest maintenance.

And look at these big advantages: light weight—lowest weight possible consistent with high-power output . . . easily disassembled for service . . . no torque reaction . . . reversing lever protected from accidental engagement but readily accessible when needed.

For *your* production or maintenance jobs, get the complete story on the new Gardner-Denver impact wrenches. Contact your nearby Gardner-Denver air tool specialist or write for bulletins.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER Since 1859

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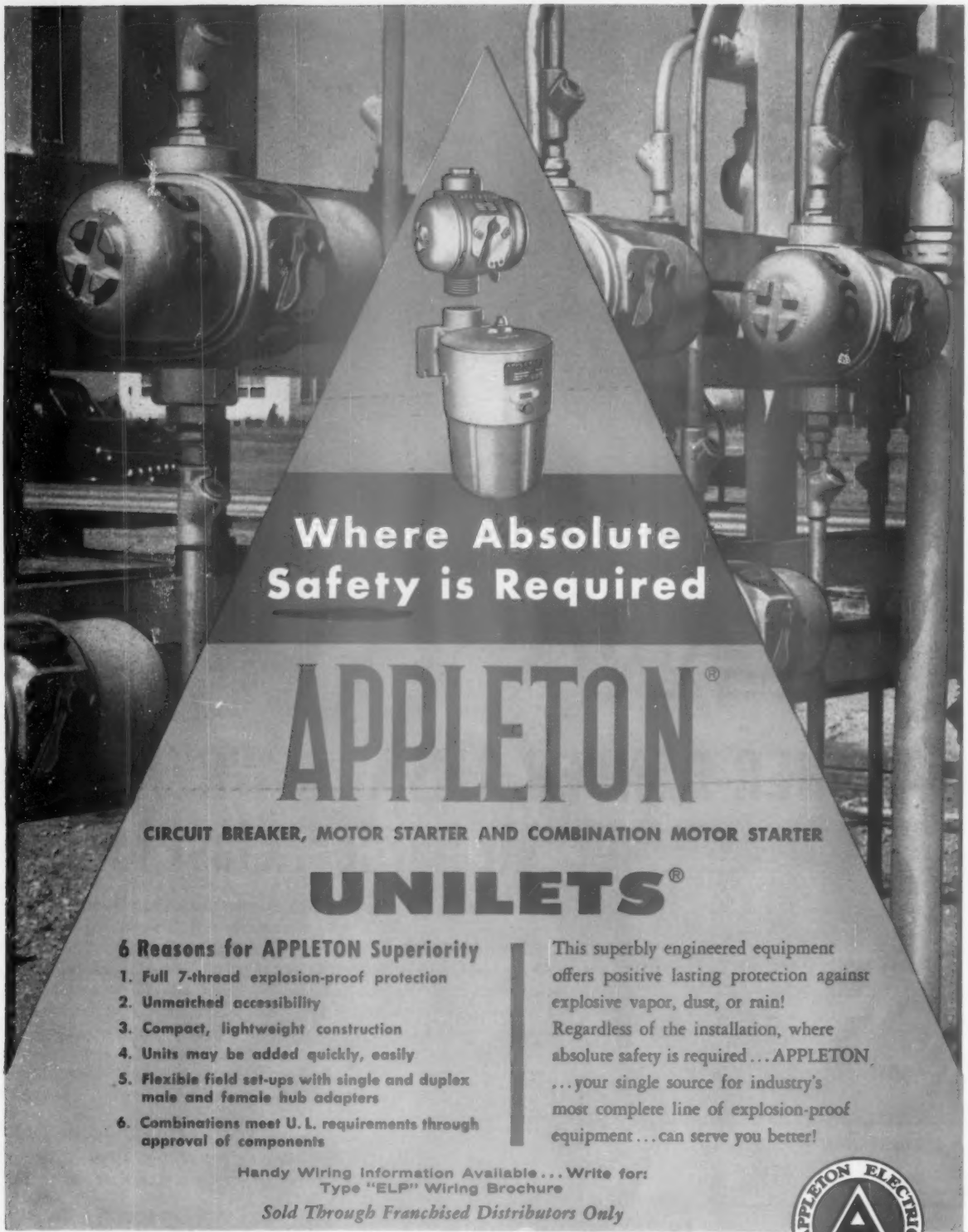

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6 Reasons for APPLETON Superiority

1. Full 7-thread explosion-proof protection
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This superbly engineered equipment offers positive lasting protection against explosive vapor, dust, or rain! Regardless of the installation, where absolute safety is required... APPLETON ...your single source for industry's most complete line of explosion-proof equipment... can serve you better!

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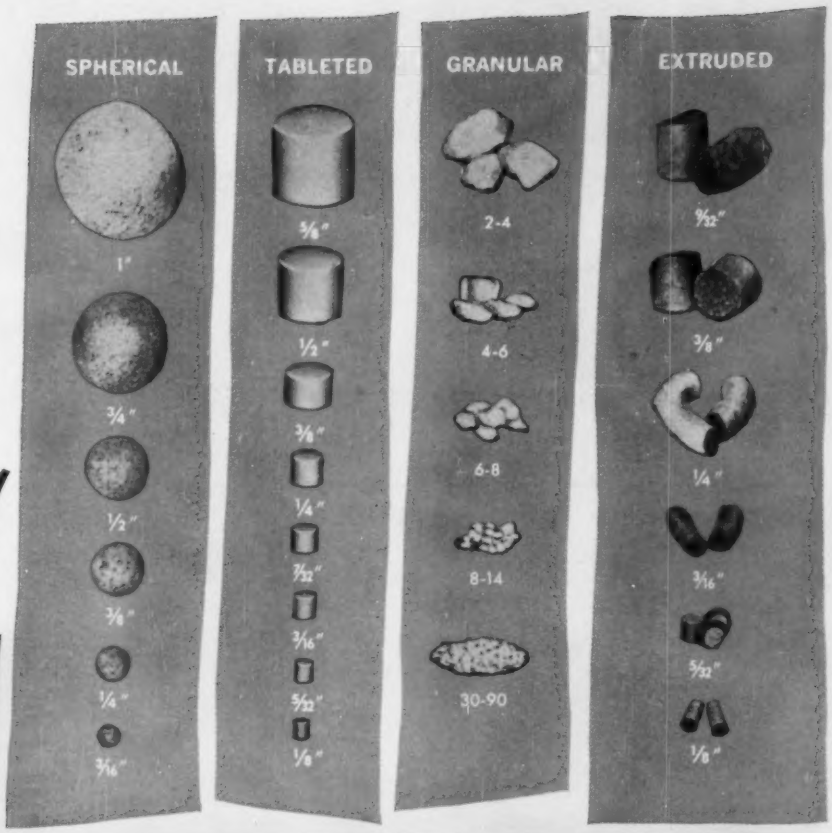
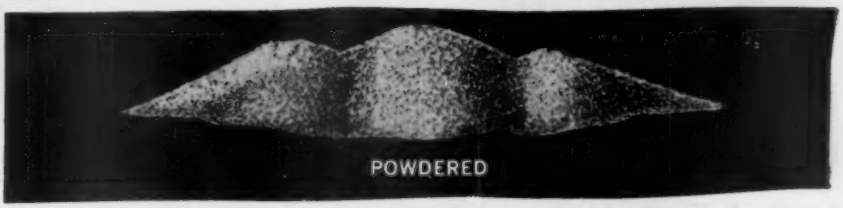
HARSHAW can make the catalyst you *Specify!*





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Nickel Carbonate	Nickel Formate	Nickel Nitrate
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Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.

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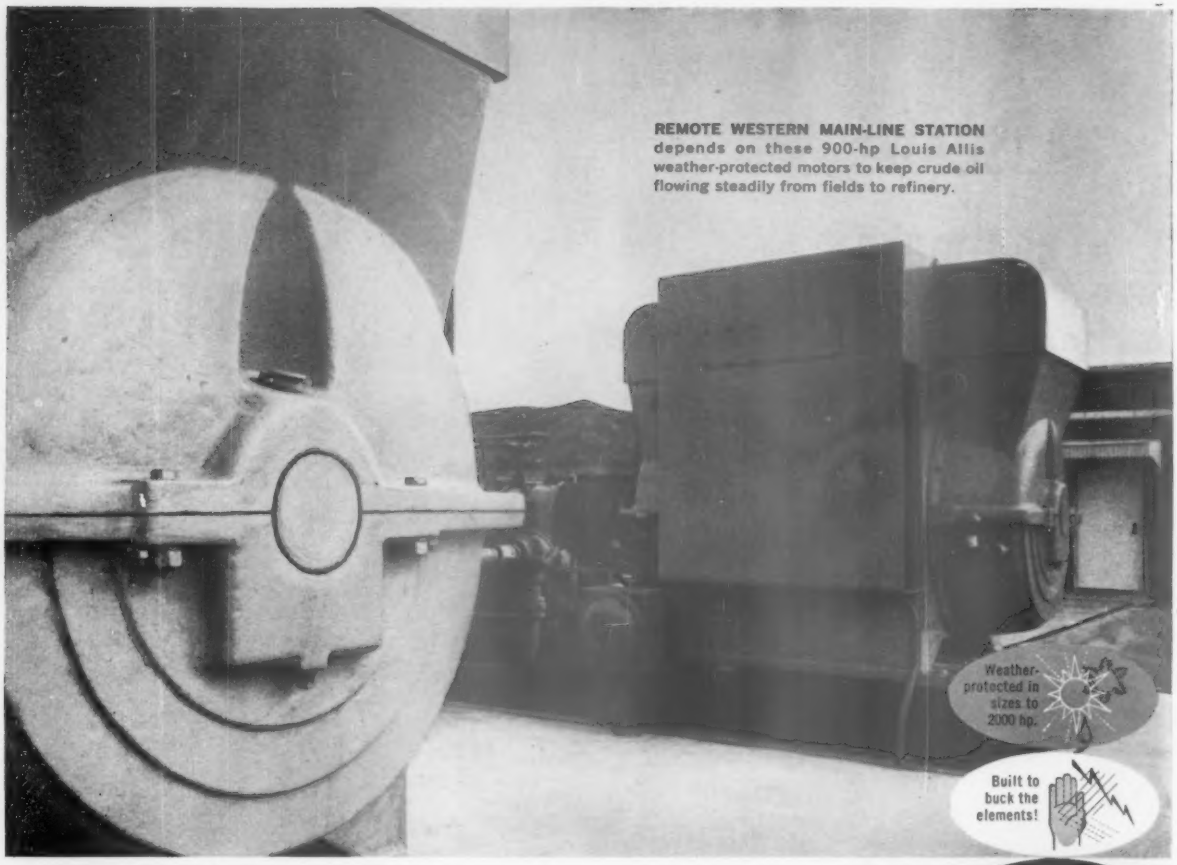

REMOTE WESTERN MAIN-LINE STATION depends on these 900-hp Louis Allis weather-protected motors to keep crude oil flowing steadily from fields to refinery.
Weather-protected in sizes to 2000 hp.
Built to buck the elements!

Here's weather-protected power for pipe-line outposts!

Louis Allis motors give you sure-power service in any weather—permit unattended operation of isolated installations.

You can count on these powerful weather-protected motors for non-stop pumping of oil from the fields to refinery and on to far-flung distribution stations. You can depend on them for virtually maintenance-free operation at any outpost. A periodic spot-check is all the attention they need.

Louis Allis all-weather design prevents contaminants from entering the motor. It assures steady power in driving rain, sleet, snow, or biting sandstorms — in bitter cold or in scorching desert heat. The treated corrosion-resistant all-welded steel housing shields the top and sides against falling and wind-driven contamination. A unique low-velocity, vertical-lift air-intake with stainless steel screens slows down cooling air and prevents air-borne dirt from being sucked into the windings.

The revolutionary MYLAR-GLASS-LECTON* insulation protects windings against corrosion and moisture — provides high dielectric and mechanical strength for long, trouble-free motor operation. Strip-type space heaters eliminate condensation problems normally present in these applications. Other long-life features include split-type cast iron bearing brackets; split-sleeve bearings with dual oil-ring lubrication; a seal and vent system to keep oil in and dirt out; and an oiler and sight gauge.

Louis Allis builds weather-protected motors in sizes from 250 to 2000 hp, with modifications to fit your needs — and provides expert engineering and field application help. Contact your Louis Allis District Office, or write for Bulletins 2550 and 2600 to The Louis Allis Co., 449 E. Stewart St., Milwaukee 1, Wis.

*MYLAR and LECTON are DuPont registered trademarks.

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

Small sample of the rigsite inventory you'd need if National Supply Stores weren't so convenient!

Imagine how your "backyard" would look if you had to maintain your own inventories. Imagine the time you would spend buying the thousands of items you might logically use. Imagine the manpower costs of maintaining stocks and keeping inventory records.

Your nearby National Supply Store takes care of all these details for you. There are actually over 65,000 different items stocked in our 120 stores. Every item is either manufactured by National under the strictest quality controls, or purchased from the leading manufacturer in any specific field. Typical of the recognized product lines you'll find in National stores are Ajax engines, Stockham fittings, Oilmaster pumps, Westinghouse motors, as well as those shown above.

Next time you buy supplies, prove to yourself that National Supply stores are your most convenient source for complete stocks of quality brands.

On next pages: Two National drawworks components to lower drilling costs

NATIONAL AUXILIARY

This National Auxiliary Drawworks Drive, installed on a National 80-B rig, gives the operator full pump power and control of rotary speeds.

Exclusive field-tested drive system permits all engines in a drive group to operate as a single pump power unit while drilling. Power is diverted to operate the rotary via the drawworks under the very accurate control of a fluid coupling. No single engine can be light loaded or severely overloaded—a condition which frequently occurs without this drive.

DRAWWORKS DRIVE

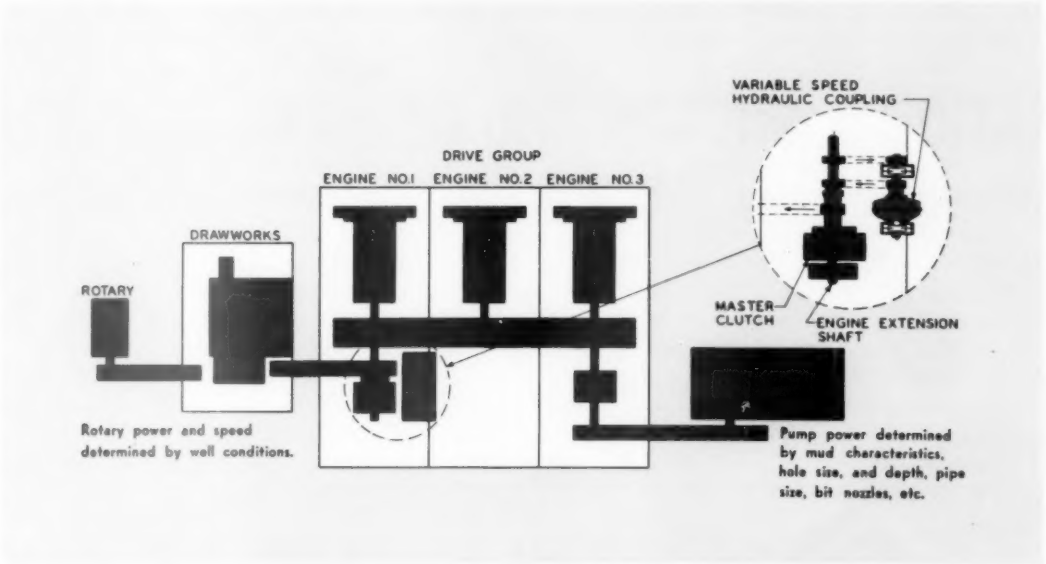
delivers maximum pump power plus complete control of rotary speeds

Drilling is faster and cheaper when you install a National Auxiliary Drawworks Drive on your rig. You can give the pumps *all available rig power* and distribute it as conditions require. And at the same time, you can drive the rotary at the *exact* speed that hole conditions require.

Here's how you benefit with this exclusive drive group arrangement: 1. Complete control of rotary table speed over the entire range from the fastest to the very slowest. 2. Fine control of drawworks input power for any operation. 3. Maximum power for pumps from *all* engines.

National has an Auxiliary Drawworks Drive for any rig, regardless of age, size, make or model. For a National rig, we offer the integral design as shown in the schematic drawing below. For other rigs, we supply the Independent Model, which is set between the drawworks and the drive group. Both provide a controlled "soft" drive to the rotary.

Ask your nearby National Supply representative to show you how these National Auxiliary Drawworks Drives deliver full pump power . . . plus complete control of rotary speeds.



This schematic drawing illustrates makeup of the National Auxiliary Drawworks Drive, consisting of a small fluid coupling, scoop controlled, mounted on a countershaft on the front engine frame. Power is transmitted to this fluid coupling by means of a chain drive from the front drive group shaft. Output from fluid coupling is transmitted by chain to the drawworks drive quill sprocket on the No. 1 engine extension shaft.

The compact #6 Micromatic unit is located directly in front of the drawworks, adjacent to the brake handle. The controls for it are directly above the driller's console. Controls can be engaged or disengaged without waste motions. After driller determines the desired amount of weight on the bit, micromatic control takes over the drilling operation and maintains this correct weight.

NATIONAL MICROMATIC DRILLING CONTROL

Automatic control speeds drilling, increases safety factor

Micromatic control brings to drilling the precise performance of your most skilled driller, without the human elements of fatigue or diverted attention.

Essentially, micromatic control is an automatic driller, operating the drawworks brake and controlling penetration rate. Feeding is smooth and continuous with the drilling string under complete control at all times.

Safety is inherent in this control. Its feeding function is operative only when the clutch for driving the rotary machine is engaged. All parts are interdependent, so failure of any component can only result in automatic restraint of feeding.

Compact micromatic controls for both straight and directional drilling are adaptable to any rig. Installation time is fast and can be done on location. See your nearby National Supply representative for complete information.

THE NATIONAL SUPPLY COMPANY

Two Gateway Center, Pittsburgh 22, Pennsylvania

Subsidiary of Armco Steel Corporation

DIVISION OFFICES: Calgary, Columbus, Dallas, Denver, Houston, Torrance, Tulsa

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Steam trap dependability is a matter of what the manufacturer puts into the trap

ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

1. Efficient, proved operating principle

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

2. Good design

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

3. Highest quality materials of construction

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

4. Good workmanship

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

5. Application know-how

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

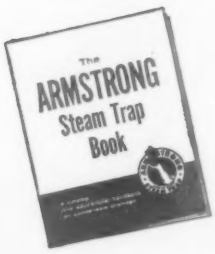
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8682 Maple Street Three Rivers, Michigan

STRONGER and SAFER for every high pressure pipeline duty...

...because they are **drop forged by Vogt**

Constantly imitated but never duplicated, Vogt forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Laboratory controlled materials and Vogt's special forging techniques assure products which are always uniform in structure, fine grained, and free from porosity. Thereby the shocks and stresses imposed by high pressures and high temperatures are easily withstood, and with stubborn resistance to erosion and corrosion. Consult Catalog F-10 for our complete line of fittings and flanges.

For a copy of Vogt Catalog F-10 address Dept. 24A-FO.

HENRY VOGT MACHINE CO., P.O. BOX 1918, LOUISVILLE 1, KENTUCKY

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OTHER VOGT PRODUCTS

Forged Steel Valves — Petroleum Refinery and Chemical Plant Equipment — Steam Generators — Heat Exchangers — Ice Making and Refrigerating Equipment.

Vogt

DROP FORGED STEEL

Fittings and Flanges

20,000 gallons of acetic acid ride in one aluminum package!

One of 50 GATX 20,000 gallon aluminum tank cars for glacial acetic acid service, delivered to Celanese Chemical Company by General American.

NEW GATX TANK CARS HAUL TWICE AS MUCH ACETIC FOR CELANESE!

Celanese Chemical Company produces millions of gallons of acetic acid—needs aluminum tank cars to transport it. Such cars, in standard 10,000 gallon size, have been supplied for many years by General American. Today a newly designed GATX car makes it possible to haul double the old quantity in one car.

Savings in freight rates, larger cargo capacity, much lighter weight per gallon of capacity, and greater product versatility are among the new GATX car's advantages. In addition to acetic acid, the 20,000 gallon GATX aluminum car can carry nitrogen fertilizer solutions, formaldehyde, hydrogen peroxide, fatty acids, acrylonitrile, nylon salts and many others.

General American builds, leases and sells a wide variety of special purpose cars. Tell us about your requirements. If there is no car exactly suited to your needs, General American can design and build one.

GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle St. • Chicago 3, Illinois • Offices in principal cities

GATX GENERAL AMERICAN TRADE MARK

You'll find it pays to plan with General American!

USS Tiger Brand — America's No. 1 Wire Rope gives most ton-miles at Cactus Drilling

Mr. Jerry Holt, tool pusher for Cactus Drilling Corporation, San Angelo, Texas, says, "About 90% of the lines I've used in my work have been USS Tiger Brand. The reason—Tiger Brand gives us more ton-miles. We know. We keep accurate ton-mile records. And Tiger Brand doesn't have to be babied."

Tiger Brand Rotary Line gives such good service because it's made from tough, strong Monitor Steel. The rope is designed with the best combination of flexibility, wear resistance and fatigue resistance for rugged oil-field use. You can get it from leading supply stores throughout the oil fields.

For our new catalog and a ton-mile calculator, write American Steel & Wire, Dept. 0151, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

Why Tiger Brand is your best buy

1. It is made by a company that maintains the most complete wire rope research and manufacturing facilities in the steel industry.
2. It is designed by one of the country's most capable staffs of wire rope engineers. It is serviced by thoroughly experienced field representatives always ready with their assistance.
3. Every type of Tiger Brand Wire Rope is designed for specific application. *You* get the *right* rope for the job.
4. It is made by *one* company, U.S. Steel, and every step of production, from ore to finished product, is carefully controlled and supervised to guarantee *one* high standard of quality.
5. Tiger Brand Wire Rope is manufactured by the largest single wire rope producer in the country.

USS and Tiger Brand are registered trademarks

7,500 feet of 1¼" Tiger Brand Wire Rope on Cactus Drilling Corporation rig near Odessa, Texas. Tiger Brand is used for its long service life and freedom from trouble.

◀ **Cutting back** the wire rope every 1200 to 1400 ton-miles is considered good, safe practice. Cuts are made at regular intervals, avoiding an excessive accumulation of ton-miles between cuts. Length of each cut is 87 feet as best suiting rig conditions.

American Steel & Wire Division of United States Steel

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Stewart & Stevenson Self-Propelled, diesel powered, Airport Utility Unit providing electric power for a giant Boeing 707 Jet Liner.

Stewart & Stevenson RIGELECTRIC engine electric power unit supplying power for drilling operations on Laughlin Porter's oil drilling rig in Africa.

STEWART & STEVENSON

When it comes to diesel or gas engine power, Stewart & Stevenson experience and "know-how" have no boundaries.

Here again are two diesel engine power applications . . . in direct contrast and in opposite parts of the world . . . with one important characteristic in common: both were designed and built by Stewart & Stevenson Services, the world's largest distributor of diesel engines. Both power applications are serving vital industries where thousands of dollars and valuable contracts are totally dependent on the reliability and performance of this engine driven equipment.

When you need power . . . for any application in any part of the world . . . Stewart & Stevenson's experience, service organization and engineering will guarantee dependable performance. We will be glad to study your power needs and submit recommendations. Please write for additional information.

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THE WORLD'S LARGEST DISTRIBUTOR OF DIESEL ENGINES

GET THE MOST

USE MISSION PUMP PARTS TOGETHER FOR LONGEST LIFE – GREATEST SAVINGS

Taken individually, the savings you get from any of these Mission pump parts is substantial. But when used together, savings pyramid and down time is drastically reduced. Here's why: each of the Mission parts is the best of its kind that can be made. Mission engineering, Mission quality control, and Mission's experience and research in pumping drilling fluids have seen to that. The truth is that a Mission piston works better and lasts longer in a Mission liner that is specifically made for it. Liners also last longer with Mission pistons because the fabric back of piston rubbers reduces the danger of serious scoring or fluid cutting. So . . . don't just half save. Use only Mission parts on all your pumps. Save all the way.

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They Say—

Don't forget the IRS

Dear Sir:

I am in complete accord with your views and indignation expressed in your editorial, "Oil Is Acquitted—but the Government Stands Indicted," (OGJ, Feb. 22, p. 56) . . . but why jump on the Justice Department when litigation by suspicion seems to be a common thing with the Internal Revenue Department?

So please add at least that department to your recommendation for investigations of the investigators. It seems to me that too many employes of our Government are getting the upper hand, or rather viciously trying to do so.

JDH
Evansville, Ind.

P. S. If you wish to use this letter, please do not use my name . . . just initials. Yes, I'm scared of them and don't want to be persecuted either!

This is education?

Dear Sir:

I am shocked. The Oil and Gas Journal wants to educate foremen and has, therefore, a "Foreman's Page." There you can read "water weighs 62.4 lb. per cu. ft. . . ."

Not a single word that there are odious things like the meter, the gram, and so on. Why shall your foremen not understand the scientist? I do not believe that the sentence "Its density is 47 lb. per cu. ft. and its gravity therefore is 0.75" is a good explanation.

Why do you not at all mention the metric system?

Dr. Otto Sova,
Vienna.

Diesels at Mercedes-Benz

Dear Sir:

In your December 21, 1959, edition, we found on page 56 an article, "Diesels Are Trying for Passenger-Car Market," in which no mention is made of the Mercedes-Benz diesel passenger cars.

As we feel that your readers should be as well informed as possible, and as our house has made important contributions to the development of the diesel passenger car, and, in fact, presented the world's first diesel car in

WITH DOWELL ENGINEERED ACIDIZING . . .

OPERATOR MAKES WELL BETTER THAN NEW

Engineered acidizing by Dowell is helping operators improve wells in many ways.

Dowell engineers use the "Acid Guide*" to design treatments for better results, lower costs, or both. Also, more and more, Dowell-developed services such as Abrasijet* (abrasive jetting service) and Rockshock* (implosive formation-treating service) are being used to pave the way for more effective acid treatments. In some instances, their use has resulted in successful treatments under conditions that were considered impossible to overcome.

Here are four recent treatments that illustrate how Dowell engineers use acid to help operators get good wells. The first is a case where engineered acidizing actually made a well better than new.

PRODUCTION INCREASED 2½ TIMES AND GAS/OIL RATIO GREATLY IMPROVED

Production from a Pecos County, West Texas well had declined from 250 to 180 bopd. Original gas/oil ratio was 1077 but had increased to 1560. Then an acid treatment, engineered with the aid of the "Acid Guide," increased production to 460 bopd. The treatment also reduced the gas/oil ratio from 1560 to 770.

The original completion was made in June, 1954. Perforations were into the Silurian (Montoyo) pay from 5118 to 5129 feet.

The engineered acid treatment recommended by Dowell used 5000 gallons of acid with a Dowell demulsifying agent added. Injection rate was five bpm at 2200 psi.

Despite the fact that the well is more than five years old, production is now considerably better than it was when the well was new.

WATER SHUT OFF--OIL PRODUCTION RESTORED WITH ABRASIJET AND MUD ACID

In Jones County, North Texas, an old well had gone to 100 per cent water. The well was completed open hole in the Palo Pinto sand between 3100 and 3260 feet. A Dowell water locator showed water entry in the zone below 3230 feet, so this zone was squeezed off with cement.

Then, Abrasijet was used to enlarge the hole and clean the formation at the most productive levels. Next, the well was acidized with 250 gallons of Mud Acid.

After clean-up, production was 56 bopd with **no water.** The operator saved a well that might otherwise have been abandoned.

KENTUCKY OPERATOR GETS 85 BOPD WELL IN AN AREA OF 15 BOPD PRODUCERS

A Dowell acid treatment resulted in a 30-day test of 85 bopd in an area where most wells drop to 15 bopd in the same period.

The well was in Muhlenburg County. Completion was through perforations into the O'Hara formation.

The Dowell treatment consisted of 1500 gallons acid with demulsifying and silicate control agents added. The operator credited these Dowell addition agents with the good results obtained.

DOWELL CUTS THROUGH TWO-FOOT MAGNESIUM BRIDGE PLUG IN SIX MINUTES

Dowell was called to acidize out a 9⅝" magnesium bridge plug that had set prematurely 90 feet below surface. The operator was afraid to drill because he could not get enough weight on the bit to balance the 2000 psi pressure below the plug.

Dowell engineers suggested the use of Abrasijet with acid. A special tool with two downward-pointing jets was run on 3½"-drill pipe and set about one inch above the plug. The pipe was held down with chains.

1000 gallons Dowell acid, carrying one pound sand per gallon, was pumped through the tool at 2500 psi. After six minutes, gas began to blow out the annulus, allowing pressure to equalize above and below the plug. The operator then went in with a bit and knocked the plug to bottom without difficulty.

Here is another example showing how Dowell uses acid **and engineering** to solve difficult problems and reduce costs. The plug was cut through in six minutes as compared to a normal drilling time of at least four hours.

Modern, **engineered** acid treatments as offered by Dowell can help producers increase their profits more than ever before. Call your Dowell representative for prompt service or detailed information. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela and Argentina. Dowell, Tulsa 1, Oklahoma. *Dowell Trademark

Services for the oil industry

DOWELL

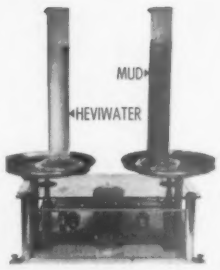
DIVISION OF THE DOW CHEMICAL COMPANY

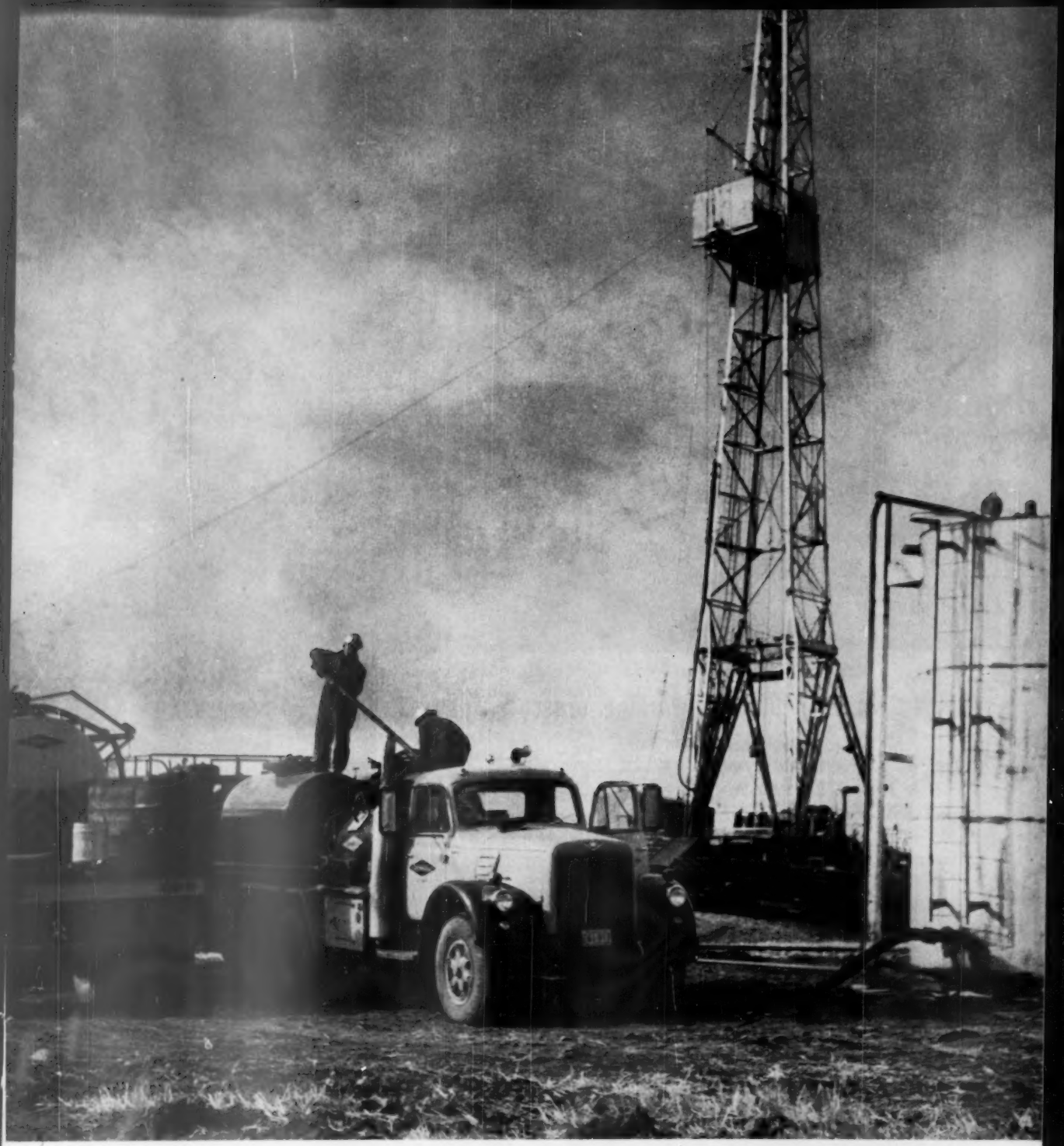
MORE IDEAS FROM DOWELL

TO HELP YOU MAKE MORE PROFIT

HEVIWATER*

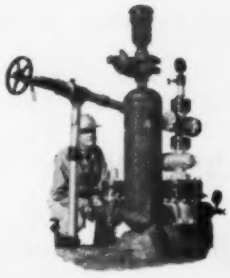
This new well completion fluid comes ready-mixed in a variety of weights. It is designed to be left, instead of mud, in the annulus above packers; also used as a protective fluid during perforating. Packer sticking and formation damage are avoided because it contains no undissolved solids. Presently stocked at Berwick, La.; can be made available at all Dowell stations.





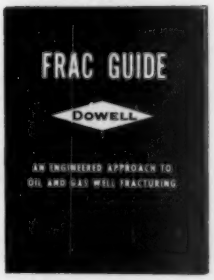
PARAFFIN INHIBITOR

This new Dowell material operates on an entirely different principle. The chemicals used do not dissolve paraffin, but are actually designed to prevent its deposition. Small amounts of the inhibitor are injected into the well periodically in the same manner as corrosion inhibitors. Careful preparation of the well is required before the treatment begins.



"FRAC GUIDE"

This Dowell collection of charts and formulas is arranged to aid in the more effective engineering of fracturing treatments. With the "Frac Guide,*" Dowell engineers can help you select the proper type and volume of fracturing fluids, sand sizes and quantities, injection rates and treating procedures — to give optimum results at the lowest possible cost.



Finest in the 1000 lb. working pressure range

This **new** 1000 wp. Tubing Head is safe, compact and economical.

1. 2000 psi Test—1000 psi Working Pressure.
2. The Top Nut contains three hammer up lugs with ample striking surface and tong space. The hammer-up lugs are positioned to facilitate use of automatic slips.
3. The Type "K" Body has a 7⅝" OD 8 RD casing thread on top for the installation of valves or other equipment.
4. The Type "K" Body is furnished with two heavy 2" integrally formed side ports which are leak-proof.
5. The Top Packing Ring is cast by a precision process which provides two perfect halves. When assembled there is virtually no split through which rubber can flow.
6. The Top Packing Element is of Hycar and is the best, most oil and gas resistant compound available for each service. Also, it is newly designated for ease of installation and requires the minimum of make-up to provide a pressure-tight seal.
7. The Top Nut and Slip Bowl will accommodate all sizes of slips interchangeably, 1" through 3".
8. All parts in the Type "K" Head are identified as to Type, Size and where necessary, the Pressure Rating.
9. The Larkin Type 'K" Tubing Head is compact, 10¼" overall, and is available with either male or female casing threads, 4½" through 7". The Type "SK" has an overall length of 14½".
10. Mandrel suspension with all the Type "K" quality is available in the Type "MK" Tubing Head.

The Larkin "K" Series Tubing Heads safely and efficiently help you effect **economies** in the 1000 lb. working pressure range. It is an important new addition for this service.

All Larkin Tubing Heads and Casing Heads are available . . . "Through Your Supply Store." Interchangeable parts are immediately available from the Larkin warehouse system which blankets the oil country.

LARKIN PACKER COMPANY
DIVISION KOEHRING COMPANY
WAXAHACHIE, TEXAS

LARKIN LEADERSHIP HAS BEEN EARNED BY YEARS OF DEPENDABLE PERFORMANCE

LARKIN
...Through Your Supply Store

1936, I am sending you some material on our activities in this field.

Artur J. Keser
Leiter der Presse-Abteilung der
Daimler-Benz AG
Stuttgart-Unterturkheim,
Germany

'Tis better to dare

Dear Sir:

In your column, "Journally Speaking," your "Lousy Monopoly" (OGJ, Mar. 7, p. 51) was well said.

It occurs to me that it may be timely to write something on the hazards of oil finding, writings that would likely be copied by others and might have a good effect on certain legislators who have exaggerated ideas about a business of which they know little.

Here is a quotation I have carefully preserved. It certainly applies to our industry, as well as all others:

"Far better it is to dare mighty things, to win glorious triumphs, even though checkered by failure, than to take rank with those poor spirits who neither enjoy much or suffer much, because they live in the gray twilight that knows not victory or defeat."—Theodore Roosevelt.

This slogan for our business should be engraved on The Oil and Gas Journal. I dare say it would be preserved by many readers.

Thomas M. Galey
Owensboro, Ky.

Cable tool depth record

Dear Sir:

We just noticed today that page C-8 of your January 28, 1959, Petroleum Panorama issue has a story crediting Hope Natural Gas Co. (one of our sister firms) with the deepest cable-tool well (Well 4190 on the Martha Goff farm, Harrison County, West Virginia, with a depth of 7,386 ft.).

The existing world's record depth for a well drilled with cable tools is held by New York State Natural Gas Corp. with its E. C. Kesselring No. 1 in Chemung County, New York.

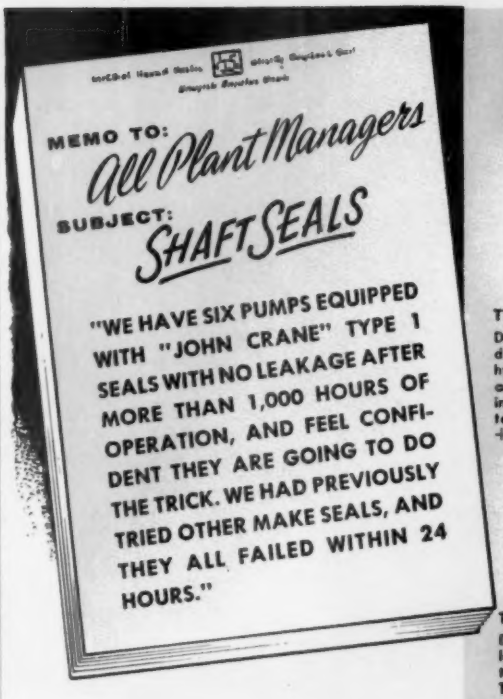
The well was abandoned in June 1953, after drillers reached a depth of 11,145 ft. without finding commercial amounts of gas.

Garland C. Raines
Director of Public
Information
New York State
Natural Gas Corp.

Missing links

Dear Sir:

I believe you omitted Nos. 19 and 20 from the reservoir engineering


MEMO TO:
All Plant Managers
SUBJECT:
SHAFT SEALS
"WE HAVE SIX PUMPS EQUIPPED WITH "JOHN CRANE" TYPE 1 SEALS WITH NO LEAKAGE AFTER MORE THAN 1,000 HOURS OF OPERATION, AND FEEL CONFIDENT THEY ARE GOING TO DO THE TRICK. WE HAD PREVIOUSLY TRIED OTHER MAKE SEALS, AND THEY ALL FAILED WITHIN 24 HOURS."

This is part of an actual memo sent by one plant manager to others of the same company in different sections of the country—and that company is now exclusively specifying these and other type "John Crane" Shaft Seals for *all* their liquid handling requirements.

You too can save time, trouble and expense by doing likewise.

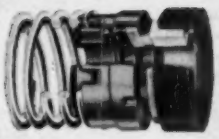
You'll find a "John Crane" Shaft Seal for every service . . . from hot or cold water to the most destructive acids and corrosives . . . high temperatures, high pressures . . . in types and sizes to meet practically any mechanical or dimensional requirement.

Send us details on your application. We'll recommend the proper shaft seal. Request Bulletin S-204-3 for complete overall information.

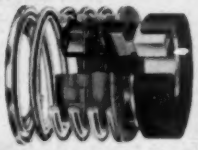
Crane Packing Co., 6419 Oakton St., Morton Grove, Illinois, (Chicago Suburb).

In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

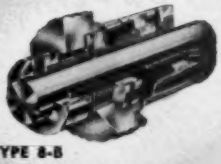
John Crane



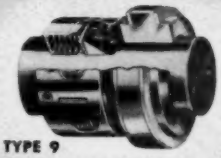
TYPE 1
Designed for limited stuffing box diameter. Handles water, light hydrocarbons, refrigerants, mild acids and other liquids non-injurious to synthetic rubber at temperatures from −40°F. to +212°F., pressures to 200 psi.



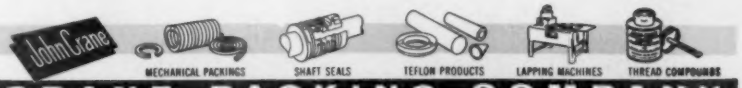
TYPE 2
Designed for limited stuffing box length. Handles same services, temperatures and pressures as Type 1.



TYPE 8-B
Heavy duty, high pressures. Packaged construction for easy installation. Handles pressures to 1200 psi., temperatures from −40°F. to +250°F. Services same as Type 1.



TYPE 9
Famous as a problem solver. Sealing members of chemically inert Du Pont Teflon. Engineered to service conditions to handle practically all destructive acids, corrosives and gases at temperatures from −120°F. to +500°F., pressures to 150 psi. Available in balanced construction for pressures to 750 psi.



R/M OIL FIELD PRODUCTS GIVE YOU MORE USE PER DOLLAR

R/M VEE-SQUARE® PACKINGS ELIMINATE MUD PUMP PACKING PROBLEMS

Experienced oilmen everywhere depend on R/M Vee-Square Packings for greater reliability in mud pump operation because they combine the advantages of non-yielding solid packing with the automatic sealing of V-ring design. Following are some of the ways in which R/M Vee-Square Packings can better your operations:

- **No sensitive gland adjustments . . . glands can be pulled up tight, as they should be**
- **Prevent blow-by between packing and stuffing box wall by means of a soft rubber cushion**
- **No rolling or riding the rod**
- **Automatic sealing through V-ring design**

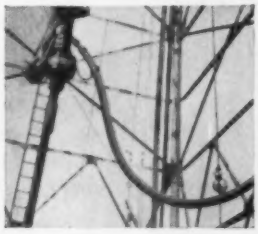
Write for your copy of R/M Products for the Petroleum Industry, Catalog P-8904, covering Vee-Square and other mechanical packings.

R/M POLY-V® DRIVES

More Power in Less Space . . . with Reliability

No other drive puts as much extra push in deep hole drilling as the exclusive, patented R/M Poly-V! Delivers much more power than a V-drive of equal width...or equal power in much less width. Single unit belt design eliminates belt matching problems in the field . . . reduces field inventories. Just *two* belt cross sections meet every heavy duty drive requirement. Maintains groove shape, complete contact pressure. Write for Poly-V Drive Bulletin M141.

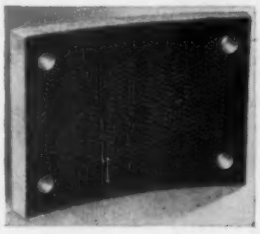
Convert to Poly-V and be SURE!



RAY-MAN ROTARY HOSE

Strong • Safe • Flexible

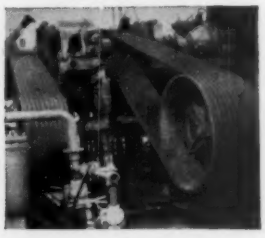
Special high-tensile steel cable wire reinforcement, precision wound under tension, gives Ray-Man CBL Rotary Hose unequalled strength and flexibility for safer, easier handling and make-up on the rig. Resists kinking and accidental crushing in transport . . . holds steadier in the derrick *without whipping*—even under high pressures of deep drilling. Streamlined, built-in coupling has no protruding lugs or flanges—features R/M leak-proof "Lip-Lok" seal that tightens under pressure to prevent blowouts! Write for Oilfield Hose Bulletin M651.



RAY-MAN BRAKE BLOCKS

Make Hole Faster

Long lasting Ray-Man 635-D Brake Blocks cost less because they wear longer. Made of extra-large asbestos yarns, special saturant, wire reinforced. Resist bleeding, won't glaze or carbonize. Ray-Man Blocks are available in drilled or countersunk sets or in the R/M patented Key-Lok style. Make hole faster. Cut cost with Ray-Man. Call your nearest R/M warehouse today or contact your closest authorized R/M oilfield equipment supply store—there is one located in every major oil producing area.



CONDOR LS V-BELTS

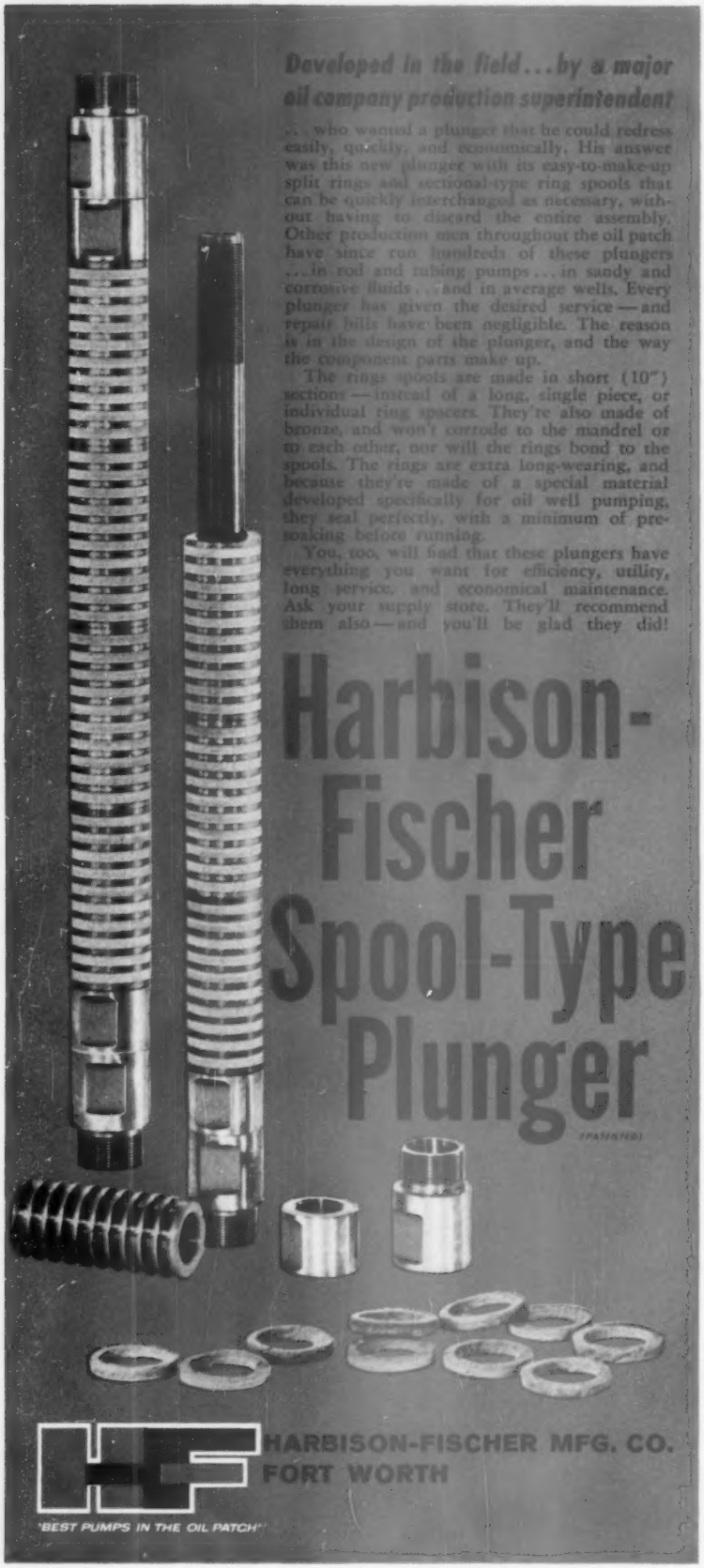
Length Stabilized

No whip, no wobble, no weave—no undue stress or V-belt turnover on long center, heavy duty oilfield drives! Condor LS V-Belts are *length stabilized* to give a degree of lateral and longitudinal stability *without stretch* never before possible. They're length *certified*, too . . . measured, tagged and vacuum packaged to assure positive length control and freshness from factory to field to drive. Condor LS V-Belts come matched—stay matched to outperform, outlast any other V-belt under the heaviest loads. Write for Bulletin M210.

RAYBESTOS-MANHATTAN, INC.

PASSAIC, NEW JERSEY

Brake Linings and Blocks • Clutch Facings and Automatic Transmission Friction Parts • Conveyor and Power Transmission Belts Industrial Hose • Rubber Covered and Lined Equipment • Mechanical Packings and Gasket Materials • Asbestos Textiles • Engineered Plastics • Sintered Metal Products • Abrasive and Diamond Wheels • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls


Developed in the field... by a major oil company production superintendent
... who wanted a plunger that he could redress easily, quickly, and economically. His answer was this new plunger with its easy-to-make-up split rings and sectional-type ring spools that can be quickly interchanged as necessary, without having to discard the entire assembly. Other production men throughout the oil patch have since run hundreds of these plungers ... in rod and tubing pumps ... in sandy and corrosive fluids ... and in average wells. Every plunger has given the desired service — and repair bills have been negligible. The reason is in the design of the plunger, and the way the component parts make up.
The rings spools are made in short (10") sections — instead of a long, single piece, or individual ring spacers. They're also made of bronze, and won't corrode to the mandrel or to each other, nor will the rings bond to the spools. The rings are extra long-wearing, and because they're made of a special material developed specifically for oil well pumping, they seal perfectly, with a minimum of pre-soaking before running.
You, too, will find that these plungers have everything you want for efficiency, utility, long service, and economical maintenance. Ask your supply store. They'll recommend them also — and you'll be glad they did!
Harbison-Fischer Spool-Type Plunger
(PATENTED)
HARBISON-FISCHER MFG. CO.
FORT WORTH
"BEST PUMPS IN THE OIL PATCH"

series by E. T. Guerrero and F. M. Stewart.

Am I right?

Kenneth I. Outwater, Jr.
Tidewater Oil Co.
Oklahoma City.

(Editor's note: Wrong. No. 19 appeared in the February 1 issue, p. 96. No. 20 was published February 22, p. 104.)

Coasting on old ideas

"On the basis of relative population, the U. S. ranks seventh or eighth in scientific achievement as indicated by Nobel prizes, and this despite the fact that countries which are ahead of us have only one-quarter to one-third of 1% of their population in college, whereas we have 1.76% of our population in college.

"The conclusion is inescapable that we, from the creative thinking viewpoint, have been coasting, reducing to profitable practice the creative thinking of our ancestors and have now reached the point of exhausted ideas and diminishing returns."

Mercer H. Parks, Humble Oil & Refining Co., in a speech to the American Petroleum Institute, southwestern district meeting, Dallas.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

MARCH

28 University of Texas, American Petroleum Institute Division of Transportation, school of pipeline technology, eighth semi-annual term, Lee College, Baytown, Tex. Term ends May 6.

28 University of Texas, American Petroleum Institute Division of Production, institute on automatic production controls, first term, Odessa College, Odessa, Tex. Term ends May 6.

28 Independent Oil Producers and Land Owners Association, Tri-State, annual meeting, Hotel McCurdy, Evansville, Ind.

28-30 Western Petroleum Refiners Association forty-eighth annual meeting, Hilton Hotel, San Antonio, Tex.

29 Petroleum Equipment Suppliers Association, Gulf Coast district membership meeting, Shamrock Hilton Hotel, Houston.

29-31 American Power Conference, annual meeting, Sherman Hotel, Chicago.

30-Apr. 1 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Broadview Hotel, Wichita.

APRIL

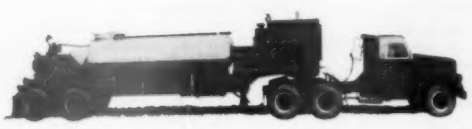
3-5 Society of Exploration Geophysicists, annual midwestern regional meeting, Washington-Youree and Captain Shreve hotels, Shreveport, La.

COMBAT WATER AT ITS SOURCE

HOWCO-SORB *helps save valuable rig time . . .*
A new fine white solid that has the ability to absorb water up to four times its weight and still remain a loose, free-flowing powder . . . over 800 percent more effective than other similar materials. Howco-Sorb when used in slug treatments dries out air drilled holes in a very short time . . . giving a quick evaluation of the water shut-off results. Howco-Sorb may be used to combat seeping water and to minimize the balling of cuttings in air and gas drilling operations.

HOWCO-SUDS *helps cut air/gas drilling cost . . .*
A new water soluble surfactant blend extremely effective in both fresh and salt water . . . is very efficient in lowering surface tension of water and capable of producing large volumes of foam under a variety of conditions. When air drilling is hindered by water accumulation, large volumes of water may be foamed from the hole. Other applications of Howco-Suds are to aid in the recovery of water from drowned gas wells, help clean out water producing wells, water injection and disposal wells and may be added to water when fracturing gas wells for water recovery.

Your local Halliburton Representative will help you investigate the many other possibilities of these Halliburton water control agents helping your operations.



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CHEMICAL SERVICES
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DUNCAN, OKLAHOMA

"275 SERVICE CENTERS — JUST MINUTES AWAY FROM YOUR WELL"

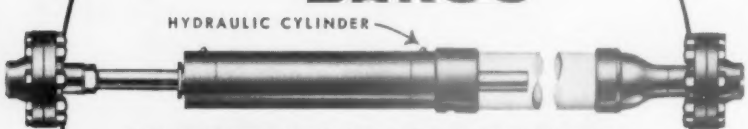
VIBRATION ?

—in Piping, Vessels, and Structures

Send for Catalog 229A

HERE'S HOW to stop it—

BARCO



"VIBRASNUB"

TRADE MARK

HYDRAULIC VIBRATION SNUBBERS

BARCO'S new "VIBRASNUB" units *allow thermal movements*, but effectively restrict rapid vibration and momentary shock loads such as may cause dangerous stresses, annoying noise, or deterioration in many kinds of structural assemblies. No reactive forces, as with spring-type dampners. "VIBRASNUB" units act instantaneously and do not rely on deceleration of movement.

Typical applications include control and protection of high temperature piping and large diameter lines in steam plants, petroleum refineries, and process plants. "VIBRASNUB" units are available from Barco factory stock and are readily adaptable to economical field use.

Barco can provide engineering data to help you solve many vibration problems. Ask for information. SEND FOR CATALOG 229A.

These pre-engineered load-carrying units help eliminate need for complicated structural designing and the design of special struts, tie-rods, slides, or pin-and-clevis arrangements. They handle *both tensile and compressive loads* and are almost always lower in first cost as well as on a life-time basis. *For complete information, ask for Catalog 229A.*

FOUNDED 1938 BARCO PRODUCTS BACKED BY EXPERIENCE

BARCO MANUFACTURING CO.

539D Hough Street • Barrington, Illinois

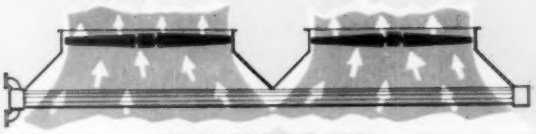
Flexible Joints • Structural Products • Construction Equipment

In Canada: The Holden Co., Ltd., Montreal

3-8	Engineers Joint Council, sixth nuclear congress, New York.
4-6	American Institute of Electrical Engineers, southwest district meeting, Shamrock-Hilton Hotel, Houston.
4-7	Oil Heat Institute of America, annual convention, Park-Sheraton Hotel, New York.
4-7	National oil heat and air-conditioning exposition, Coliseum, New York.
4-8	Society of Automotive Engineers, national aeronautic meeting, Commodore Hotel, New York.
5	Petroleum Equipment Suppliers Association, southern mid-continent district membership meeting, Statler Hilton Hotel, Dallas.
5-6	University of Kansas, eighth annual gas compressor institute, National Guard Armory, Liberal, Kans.
5-7	Instrument Society of America, national chemical and petroleum instrumentation symposium, Rochester, N. Y.
7-8	Rocky Mountain Oil and Gas Association, midyear meeting, Newhouse Hotel, Salt Lake City.
8	Chemical Institute of Canada, rubber chemistry division, annual meeting, Kitchener, Ont.
12-14	Petroleum Industry Electrical Association, Petroleum Electric Supply Association, conference and exhibition, Municipal Auditorium, Kansas City.
15-16	Society of Economic Paleontologists and Mineralogists, Permian Basin section, annual meeting, technical session and field trip, Windsor Hotel, Abilene, Tex.
15-16	Society of Economic Paleontologists and Mineralogists, Pacific section, annual spring field trip, Panoche Hills, San Joaquin Valley, California, and evening meeting, The Hacienda, Fresno, Calif.
19-21	University of Oklahoma, College of Engineering, southwestern gas measurement short course, north campus, University of Oklahoma, Norman.
19-21	American Society of Lubrication Engineers, annual meeting and lubrication exhibit, Netherland Hilton Hotel, Cincinnati.
20	Chemical Institute of Canada, joint meeting, Quebec rubber and plastics group and Montreal section, Queen's Hotel, Montreal.
20-22	American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Gladstone, Henning, and Townsend hotels, Casper, Wyo.
20-22	National Petroleum Association, semiannual meeting, Hotel Cleveland, Cleveland.
21-22	Oklahoma State University, technical conference on heat transfer, Stillwater, Okla.
21-22	Texas Technological College, seventh annual West Texas oil lifting short course, Lubbock, Tex.
24-26	Independent Petroleum Association of America, midyear meeting, Denver Hilton Hotel, Denver.
25-26	American Society of Mechanical Engineers, maintenance and plant engineering conference, Chase-Park Plaza Hotel, St. Louis.
25-27	Southern Gas Association, convention, Buccaneer and Galvez hotels, Galveston.
25-28	American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
25-29	American Welding Society, annual

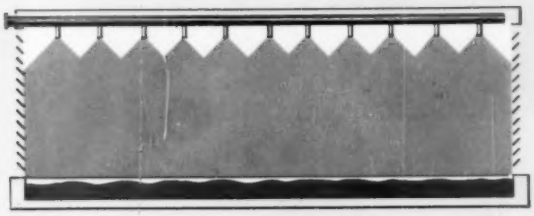
Should Process Plant Cooling Systems Use..

AIR ——



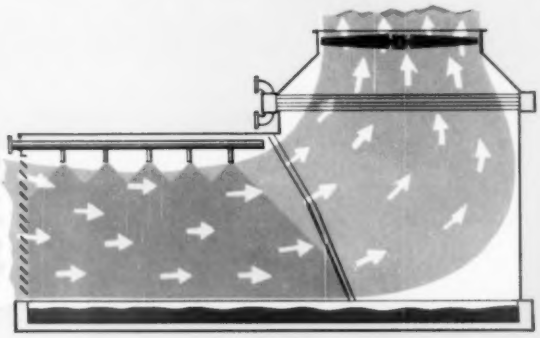
HUDSON SOLO-AIRE UNITS

WATER ——



HUDSON COOLING TOWERS

or a combination of AIR AND WATER ——



HUDSON COMBIN-AIRE UNITS

The answer is found only through comparisons of economics of air, water or a combination of the two for cooling each process stream, and incorporating the results in one integrated cooling system. Factors to be considered include desired effluent temperature of each process stream; summer and winter ambient dry and wet bulb temperatures; availability and quality of water; possibility of public water pollution; space available; and first cost, maintenance cost, and operating cost of equipment.

HUDSON is unique in supplying water cooling towers, Solo-aire units, and Combin-aire units to comprise integrated cooling systems utilizing air and water in economic ratios. With the collaboration of owners' engineers, HUDSON has designed integrated cooling systems for a wide range of process and climatic conditions. Hundreds of HUDSON installations are operating in the United States, Ireland, England, France, Spain, Norway, Saudi Arabia, Pakistan, the Philippines, Mexico, Chile, Peru, Venezuela, and Canada. HUDSON experience, available without obligation in integrating the cooling system with process design, will be most valuable to plant owners if utilized during planning stages.

In early design stages of future projects let HUDSON collaborate with your engineers in selecting the integrated cooling system which best balances capital investment and operating cost for the specific process, climatic and water conditions.

HUDSON

ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

ONLY HUDSON OFFERS ALL **3** *TYPES OF COOLING EQUIPMENT*

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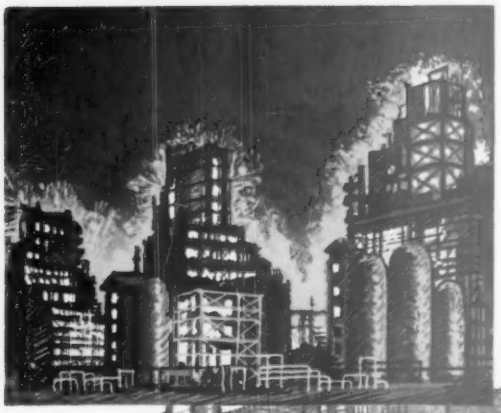
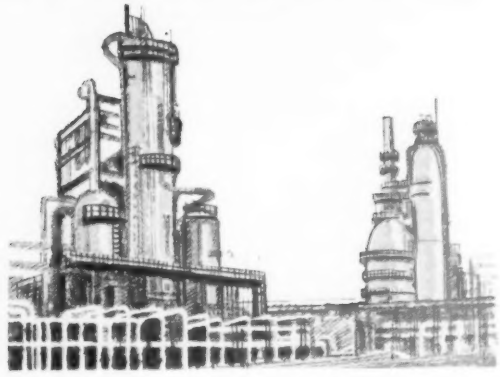
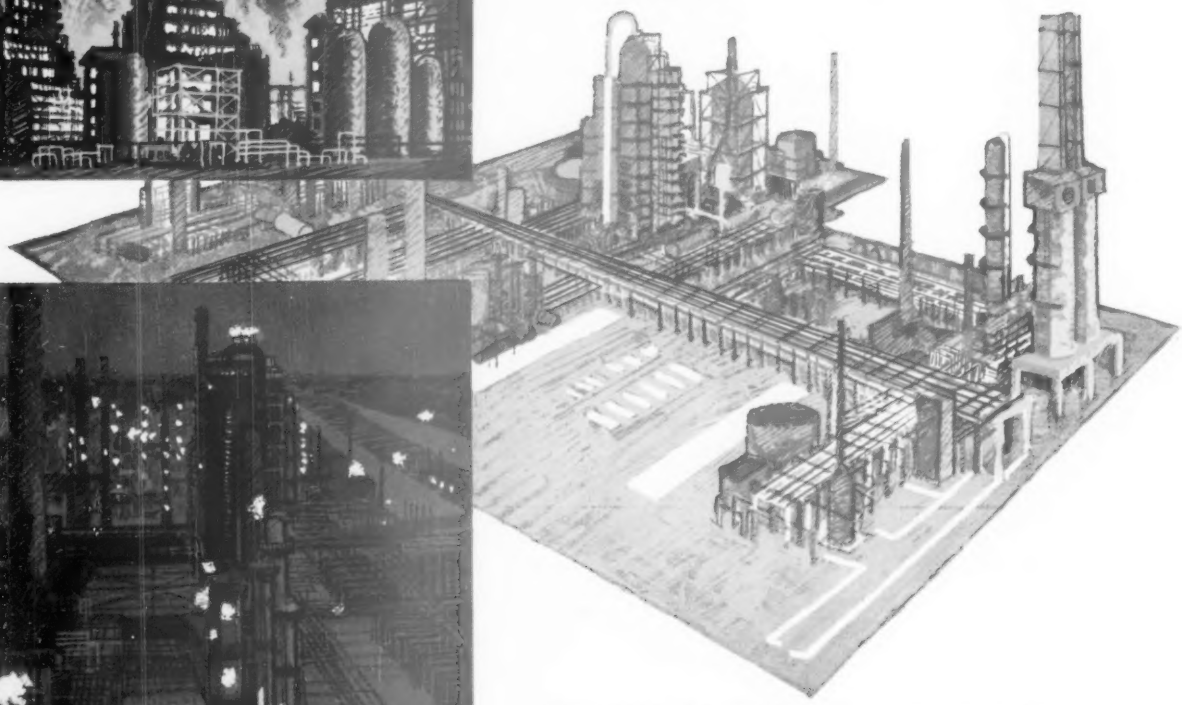
Who we serve proves *how* we serve







Since 1923, the world's leading petroleum refineries, chemical plants and other process installations have operated with the aid of Pacific centrifugal pumps. Their satisfaction with the cost-cutting efficiency provided by Pacific pumps is apparent in continuing repeat orders for plant expansion and new facilities.

There are several advantageous reasons for these re-orders; among them: (1) Pacific is a specialist in the development, design and manufacture of centrifugal pumps. (2) Pacific manufactures a wide variety of types and sizes to fill specific needs at the most beneficial cost/efficiency level. (3) Pacific provides technical advice and counsel to customers through an experienced sales engineering staff. (4) Pacific pumps may be financed in the leading currencies of the world.

There are other reasons why Pacific can serve you best. We would welcome an opportunity to tell you about them.

PACIFIC

Offices in all Principal Cities

PACIFIC PUMPS

Inc. . . A Division of Dresser Industries, Inc.

HUNTINGTON PARK, CALIFORNIA

IR-3

meeting and welding exposition, Los Angeles.

27-29 Natural Gasoline Association of America, annual convention, Rice Hotel, Houston.

28-29 American Petroleum Institute, Division of Transportation, pipeline conference, Mayo Hotel, Tulsa.

28-29 Pacific Coast Gas Association, distribution conference, Benson Hotel, Portland.

MAY

1-3 Texas Independent Producers and Royalty Owners Association, fourteenth annual membership meeting, Holiday Inn, Carlton and Blackstone Hotels, Tyler, Tex.

1-4 American Petroleum Institute, Division of Transportation, tanker conference, Seaview Country Club, Absecon, N. J.

2-3 Society of Petroleum Engineers of AIME, North Texas section, fourth biennial secondary recovery symposium, Wichita Falls, Tex.

5-6 American Institute of Mining, Metallurgical and Petroleum Engineers, annual joint meeting of Rocky Mountain petroleum sections, Calgary.

5-6 Canadian Institute of Mining and Metallurgy, annual technical meeting of petroleum and natural gas division, Palliser Hotel, Calgary.

9-12 American Petroleum Institute, Division of Refining, midyear meeting, Statler and Sheraton-Cadillac hotels, Detroit.

9-12 Instrument Society of America, instrument-automation conference and exhibit, Civic Auditorium and Brooks Hall, San Francisco.

9-13 American Gas Association, distribution and transmission meeting, Jung and Roosevelt hotels, New Orleans.

11-12 University of Kansas, gas conditioning institute, National Guard Armory, Liberal, Kans.

11-14 Fluid Controls Institute, spring meeting, The Greenbrier, White Sulphur Springs, W. Va.

12-13 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.

12-14 Kansas Independent Oil and Gas Association, annual meeting, Lassen Hotel, Wichita.

16-17 International Society of Professional Well Log Analysts, first annual meeting, Tulsa Hotel, Tulsa.

18-20 American Petroleum Institute, Division of Marketing, midyear meeting, Statler-Hilton Hotel, Cleveland.

22 Pennsylvania State University, short course in reservoir engineering, University Park, Pa. Term ends June 10.

22-26 Air Pollution Control Association, annual meeting, Netherland-Hilton Hotel, Cincinnati.

22-26 American Society of Mechanical Engineers, oil and gas power conference, and exhibit, Muehlebach Hotel, Kansas City.

23-24 American Gas Association, production meeting, Roosevelt Hotel, New York City.

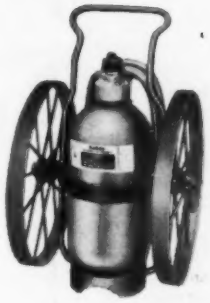
24-26 American Right of Way Association, annual seminar, Shoreham Hotel, Washington.

25-27 Pacific Coast Gas Association, accident prevention and transmission conference, Hotel Utah, Salt Lake City.

25-28 American Association of Petroleum Geologists, western Canada regional meeting, Banff Springs Hotel, Banff, Alta.

26-27 Natural Gas and Petroleum Association of Canada, meeting, Niagara Falls, Ont.

NOW! GET FULL-POWER FIRE FIGHTING WITH KIDDE'S DRY CHEMICAL LINE!



2½ and 5 pound pressurized units! Granted top rating by U.L., these two units pack the extra punch needed to get the jump on fire. For example, the 2½ pound Kidde unit is as compact as a 1 quart carbon tet model, yet is eight times as powerful! Both the 2½ and 5 feature simple, two-step operation, easy-to-read dust-and-moisture-proof gauges. 10 pound dry chemical also available.

20 and 30 pound pressurized dry chemicals! Both these Kidde units have the same good features of the 2½ and 5, plus some "extras" all their own. Center balanced for fast action, rugged diffuser horn, speedy trigger operation, recessed pressure gauge and enclosed mechanism.

200 pound dry chemical wheeled unit! Kidde's 200 pounder discharges a 40-foot stream faster, has an *extra* 50 pounds of fire-smothering dry chemical to knock down fire quicker. Low center of gravity and wide wheels make it easy to maneuver. Easy-to-use discharge control makes operation simple.

400 pound stationary unit! Here's maximum protection in a minimum package! Like all Kidde units, this features sure, dependable performance and fast, easy operation. Either wall-mounted or free standing, leakproof and tamperproof, exclusive Bridgeman Seal, universal long-range nozzle, easy-to-read pressure gauge. 200 pound model also available.

Get the jump on oil, gas and electrical fires! Learn more about the complete line of dependable, efficient Kidde equipment—write today!

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New Process * GUARANTEES

Lowest Product Recovery Cost
Shortest Unit Payout Time

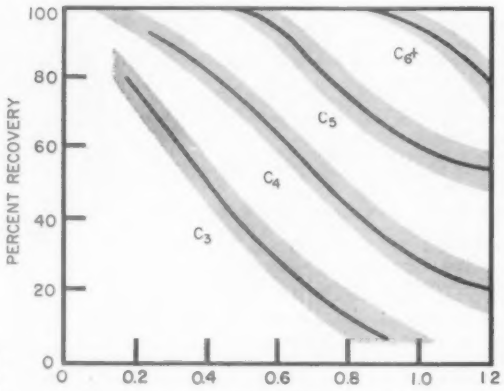
The Adsorption Process

DELTA DRYEX GASOLINE PLANT

The most economical commercial gasoline, butane and propane recovery process ever designed.

* Delta quotes a turnkey onstream installation with guaranteed recoveries.

- **A new concept for natural gasoline, butane and propane recovery.**
- **Recovers *both* natural gasoline and NGAA specification butane and propane.**
- **You get more product at a much lower cost (half in many cases) than any other commercial process.**
- **You are assured of shortest unit payout time.**
- **Dryex adsorption gasoline plants are complete including fractionation and refrigeration equipment which yield NGAA specification products.**



Dryex gasoline plants open a new realm of profit possibilities. Even those gas streams considered for other processes in the past and eliminated as economically impractical should be reviewed for a Dryex gasoline plant application.

For Brochure and Complete Information, Write:

LET DELTA ANALYZE YOUR GAS STREAM TO DETERMINE THE VALUE OF DRYEX TO YOU

Patent No. 2,880,818 dated April 7, 1959

DELTA

DELTA TANK MANUFACTURING CO., INC.

P. O. BOX 1469 • BATON ROUGE, LA. • TEL. Dickens 3-5701

the Journal said...

50 years ago

March 20, 1910

Preston, for several months the scene of one of Oklahoma's biggest oil booms, and at the start expected to become one of the state's most important fields, is taking on the appearance of a collapsed bubble. An increasing number of failures, heavy salt-water encroachment, and sharp drops in production are causing companies to suspend or slow up drilling programs and other work planned for this new Okmulgee County field.

W. H. Hammon, president of Hope Engineering & Supply Co., surveying northwestern Louisiana fields for availability of gas to supply a proposed pipeline to St. Louis, estimates gas wastage in the expansive Caddo field alone at more than 200 M.M.c.f. daily.

25 years ago

March 28, 1935

Kansas' daily average production of 153,050 bbl. last week sets new all-time high for that state. Active development in new fields boosts completions and starting operations.

The Oil and Gas Journal's annual survey records more operating refineries than at any time in history. The number totals 687 with daily crude-oil capacity of 4,281,-694 bbl.

Increase in flow of Humble Oil & Refining Co.'s Anahuac discovery well in Chambers County, Texas Gulf Coast, further supports belief another major field has been found. Flow jumps from 12 to 30 bbl. per hour through ⅝-in. choke from 7,028-88-ft. Frio pay. New field is eighth on Gulf Coast to produce from depths below 7,000 ft.

10 years ago

March 30, 1950

Pipeline industry's first steam-turbine-driven centrifugal compressors are to be used on Transcontinental Gas Pipe Line Corp.'s 1,800-mile gas line from South Texas to New York. New line, now nearing completion, also will have first extensive microwave communication system.

West Central Texas' reef-field trend continues country's "hottest" spot. Further stepup in activity follows new long south and west extensions in Scurry, Borden, and Kent counties.

U. S. Navy continues extensive exploration work on Arctic Alaska Petroleum Reserve with announcement of seven-well drilling program for remainder of 1950. Seven geological parties to operate during summer months.

JOURNALLY SPEAKING

Surveys Don't Just Happen

BOB BIZAL, the Journal's editorial research director came into the office one day last November. "It's time," he said, "to get the refining survey under way."

The survey information, which must be obtained from the companies themselves, goes into this, the ANNUAL REFINING NUMBER as tables of capacity for U. S. and Canadian refineries. The Journal's task is to obtain it, interpret it, tabulate it, and print it.

Bob wanted to know whether there had been any significant changes in refinery processing during the past year. If some new process is being installed generally in refineries throughout the country, it belongs in the tabulation. If refiners have asked for more information, that belongs in the table. Since there have been no major developments during the past year, the answer was, "No."

Bob then compiled the survey forms, had them reproduced, and wrote the covering letter. This is an important letter because it explains our reason for making the survey (a service to the industry) and outlines the bases for reporting unit capacities and new construction. It explains how and why we want unit types and capacity figures reported. In short, it explains why we design our questionnaire the way we do.

Bob had the letters and survey forms ready by December 1. They went into the mail that day to about 200 companies which operate nearly 350 refineries. Then began the period of waiting. Our respondents are busy people, and even though each profits by having the final tabulation, the questionnaire must take its place in the large work pile. Even so, many of the returns were in Bob's hands within a week or 10 days after mailing.

About a month after the first mailing, the survey was about 50% complete, but the returns had dropped to practically nothing. So, just after the year-end holidays, Bob wrote a letter reminding those who hadn't replied. This letter elicited a flurry of replies. A third letter went into the mail early in February, and this was followed by special-delivery letters, telegrams, and long-distance phone calls. Editors in our Houston, New York, and Los Angeles offices also made personal contacts in these areas. Finally, just before press time, the return reached 100%.

Meanwhile, Bob checked each reply carefully. He looked at the replies from this particular company for previous years. If there were inconsistencies, he contacted the company, asking (courteously) whether the FCC unit has become a TCC, or whether the refiner no longer has the Platformer reported last year.

Eventually all questions were resolved. Then Bob carefully tabulated the information for the typesetter. But his task wasn't over. When the galley proofs were ready, he spent several hours more, laboriously checking proof against copy, figure by figure. When this was done, he breathed a sigh of relief.

However, he didn't have time to rest. The natural-gasoline survey, which he started in "spare moments" during the refining survey, was crying for his attention. Meanwhile, too, he wrote Journal press releases, designed reader-promotional material, wrote letters to Journal authors and others who have helped us with stories and articles, and carried out a host of other routine duties.

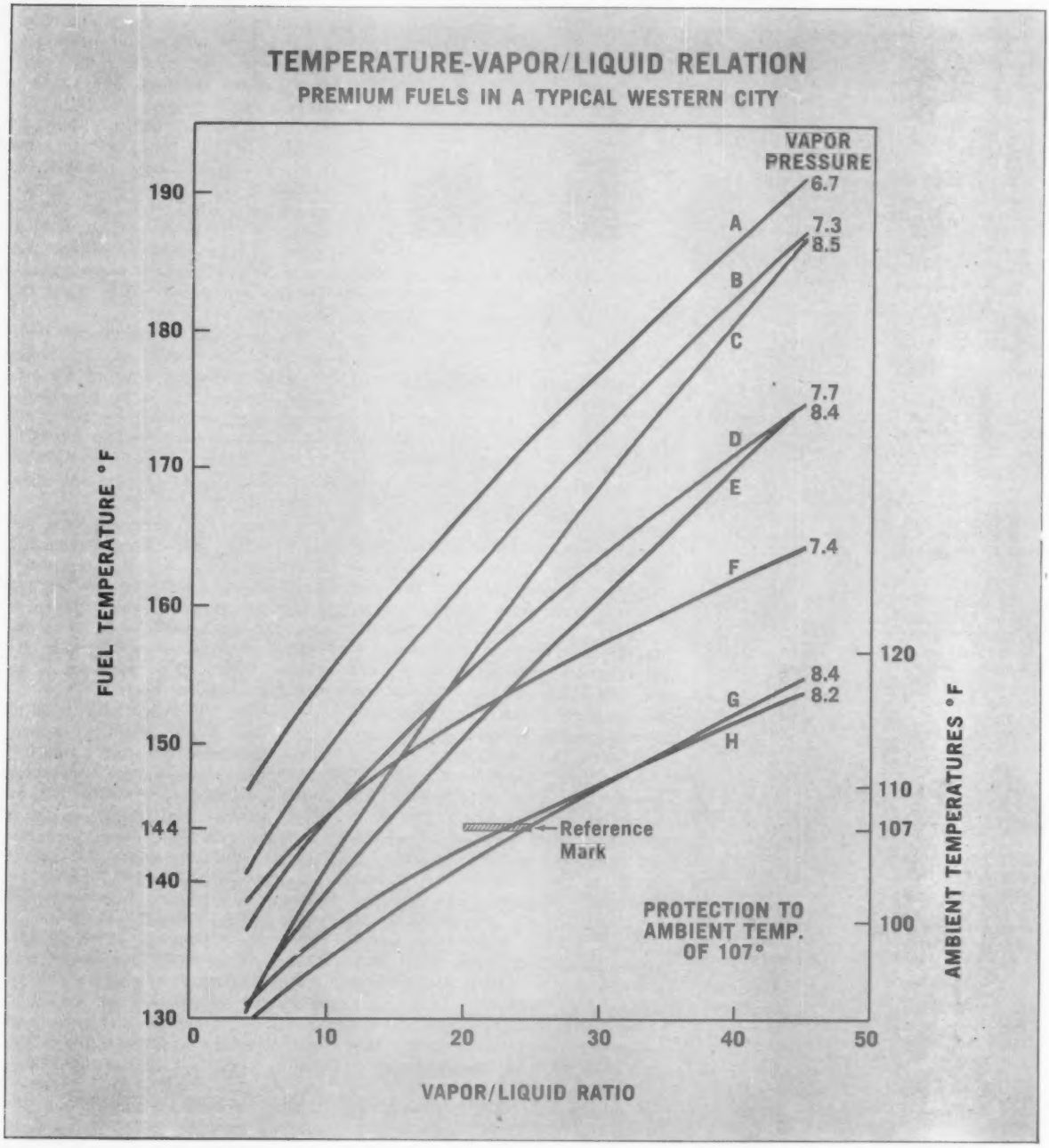
The natural question is, "Is the survey worth all this?" Our letters from grateful refiners indicate that it is. We know refiners who put a team of men to work on the survey immediately when it is available to them. The results from their analyses help them in planning crude runs, marketing strategy, and future construction. It's another Journal service tailored to meet the needs of the industry.

—Gerald L. Farrar

Here's a practical method for analyzing Front-End Volatility

Ethyl Research uses temperature-vapor liquid ratio curves to study relative and absolute front-end characteristics of gasoline

by **GILBERT WAY**—*Research Representative*



The above curves were calculated by the CRC method using Ethyl Volatility Survey data.

WHERE TO SET front-end volatility for optimum balance of economic and automotive benefits is an important question for refiners.

One result of Ethyl's work in this field is a routine approach to interpretation and comparison of seasonal volatility data. The method can be used to establish or review volatility requirements at both the refinery and marketing levels. Data from the Ethyl Volatility Survey are used as the basis for temperature-V/L studies. *Refiners may have analyses of their own marketing areas upon request!*

Method is Simple; Easy to Understand

Temperature-V/L ratio curves—widely accepted as a graphic representation of how gasoline vaporizes in a fuel system—are used to show the volumes of vapor formed per volume of liquid at any given gasoline temperature. (Curves were calculated by the CRC method.)

In addition to showing relative vaporizing tendencies among various fuels, the curves may be related to reference points that indicate average conditions of fuel temperature and limiting V/L in automotive fuel systems. In the accompanying graph, average conditions for premium fuels are shown by the reference mark ranging from 20 to 25 V/L at a fuel temperature of 144°F.

This reference mark range was established from the results of extensive road tests conducted in recent years. Many factors were considered in arriving at this practical bench mark, such as severity of test conditions, age and condition of fuel system components, and variation of individual cars from average characteristics.

In theory, a fuel having a curve which passes through the reference mark would represent highest desirable use of front-end "fill." Those above the mark would be more conservative and those below subject to vapor lock.

The estimate of fuel temperature was established by adding the temperature rise at the fuel pump under severe vapor locking conditions and the ambient temperature to which protection against vapor lock is desired. Experience has shown that this fuel temperature rise at the pump averages 37°F. In the marketing area represented in the graph, protection is desired up to 107°F.

Some Interesting Observations on Volatility

The figure shows a wide variation in vaporizing tendency of fuels. Fuels A, B and C indicate a conservative position. This is contrasted by high volatility and border line protection against vapor lock by curves of fuels G and H.

Curves having steep slopes are typical of fuels pressurized by butane. Those with flat slopes indicate a high pentane content. Fuels C, E and G have essentially the same Rvp of 8.4 to 8.5. They converge at a V/L of 4, the V/L of the Reid vapor pressure bomb.

A V/L of 25, however, is reached by fuel G at a fuel temperature of 144°F., whereas fuel C must reach 163°F. before evolving the same quantity of vapor. Thus fuel C offers more protection against vapor lock than fuel G when abnormally high temperatures are encountered. This illustrates that, *for a given Rvp, butanized* fuels offer greater vapor lock protection in motor vehicles than fuels that are pressurized largely by pentane. Another way of comparing these two fuels is at constant temperature: at 150°F., fuel G has 35 V/L, fuel C only 16.

How Ethyl Research can help you

In addition to participating in Oil Industry cooperative studies, Ethyl Research has worked with many individual oil companies in studies of vapor locking tendencies of fuels and engines.

The experience gained in these programs provides a broad understanding of the problems associated with front-end volatility.

Our engineers are prepared to bring you analyses of Temperature-V/L characteristics of fuels from marketing areas of your choice.

If you would like this service, or more information about it, just call your Ethyl Representative. He'll be glad to make the arrangements.

ETHYL ANTIKNOCK COMPOUND — ETHYL CORPORATION

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Ethyl Corporation of Canada Limited, Toronto
Ethyl USA (Export) New York 17, N. Y.

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How to beat the oversupply problem

THE WEATHER played an ironic trick on refiners this winter. During most of the heating season it was so warm that demand for distillate was far below the forecasts. Now the windfall of a March cold spell is reducing excess inventories at an unexpected rate.

But refiners played an even worse trick on themselves. By not tailoring their runs closely enough to actual demand, they enter spring with product stocks so far above desirable levels that they could be plagued with low prices the rest of the year.

The recent cutback in runs is encouraging. But it is not enough below the normal spring curtailment to eliminate the surplus unless it is continued for many months and participated in by all refiners.

SOME SMART REFINERS have found ways to beat this situation. Instead of producing more than they can sell through normal channels at reasonable prices, they cut their runs and fill their needs with excess distress products of others picked up at bargain prices.

Both large and small refiners are doing this. And some in each category are showing earnings far above the average for the industry.

Example: One Gulf Coast refiner stepped up its runs to maximum capacity for a recent month, and kept careful cost records. The incremental barrels reduced unit costs impressively and the refinery manager made a good showing, though unsold inventories mounted fast. But top management discovered that it could buy products from others at less than it cost to make them even running full tilt. Since then it has cut runs deeply and is making a profit on reselling the distress products of others.

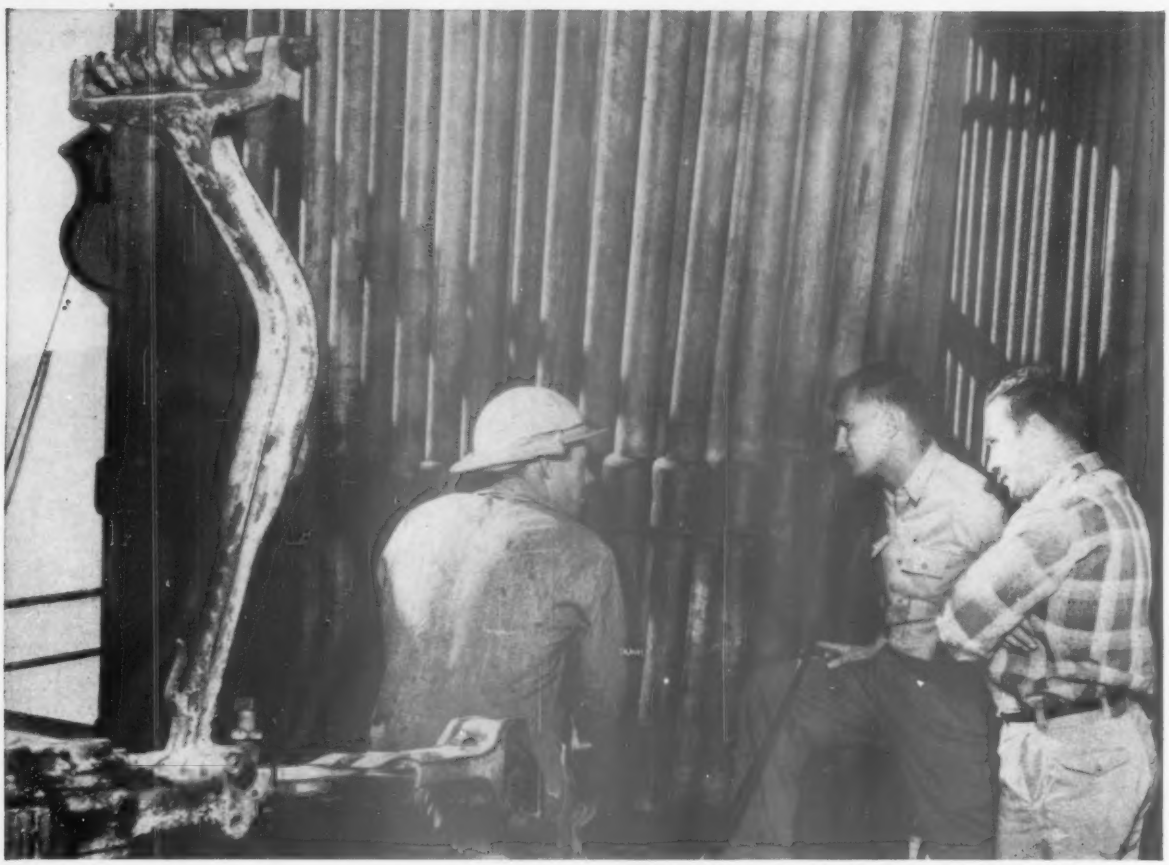
Example: A Rocky Mountain refiner last fall discovered that its push to expand volume and territory resulted in many unprofitable sales and practices. It eliminated them, cut runs 17% below last summer's level, and is enjoying a comfortable profit on its lower volume.

It sounds like good business not to make products at a cost higher than they can be sold for, or higher than they can be bought from others.

IF ENOUGH REFINERS would adopt similar policies, excess runs and below-cost sales would soon disappear. Those dumping distress stocks would soon wise up to the fact that competitors were cashing in on their foolishness.

That kind of individual attention to balance sheets and market opportunities will do more to cure the ills of refining and marketing than all the current accusations and yak-yak over who is to blame and what should be done.

The best advice for everybody today is that given the industry back in 1923 by the late Henry L. Doherty: "What we need is less wind and more work, less talk and more thought, less bellyaching and more brainwork, less bile and more guts."



Checking the 4340 nickel alloy steel pipe during drilling of the world's deepest exploratory well — Phillips 1-EE University. The top portion of the string was made up of this 4340 pipe when the well hit 25,340 feet.

World's deepest well completed with the help of nickel alloy steel drill pipe

When Phillips 1-EE University Well reached beyond 23,000 feet, the drilling crew halted operations. At these depths, drill string failure was a dangerous possibility.

The drillers' job was to keep it from happening.

They did it by running in 10,500 feet of nickel alloy steel drill pipe as the top section of the string. Drilling began again, and the well was completed at a world's record 25,340 feet.

National Supply Company, maker of the 3½-inch drill pipe used at the well, names it "Spang P-105". It's made from 4340 nickel-chrome-moly steel, heat-treated to a yield strength of 105,000 pounds per square inch.

Nickel alloy steels long ago proved their dependability in the oil fields where only the best is good enough . . . in rock bit cutters and hole reamers, in fishing taps and slip liners, in pumps and sucker rods.

In your own drilling operations, remember that nickel alloy steel parts are your best insurance against equipment failure.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N.Y.

View of the Phillips Petroleum Company rig in Pecos County, Texas. Nickel alloy steel drill pipe is in position and ready to be run into the hole.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER

The JOURNAL'S Forecast of U. S. Refining	CAPACITY			CONSTRUCTION	
	Jan. 1, 1959	Jan. 1, 1960	(Estimated) Jan. 1, 1961	1960	1961
Crude					
BPCD	9,615,787	9,789,355	9,852,080	62,725	6,410
BPSD	10,154,155	10,360,868	10,431,032	70,164	6,800
		(Feed, BPSD)			
Thermal Cracking	2,103,455	2,029,555	2,048,055	18,500	2,500
Cat Cracking	4,567,860	4,799,230	4,897,735	98,505	5,000
Cat Reforming	1,848,885	1,912,840	1,970,010	57,170	0
Hydrogen Treating	1,713,415	1,941,390	2,038,130	96,740	15,945
		(Product, BPSD)			
Alkylation	370,120	407,425	420,950	13,525	7,100
Polymerization	145,040	148,300	149,180	880	0
Lubes	179,615	182,565	184,465	1,900	0
Coke (Tons per day)	14,600	16,198	16,963	765	0

Refiners Shoot for Improved Products

• Hydrogen treating is making the big noise in the refining industry. It shot up 13.3% last year. The Journal's annual survey shows crude capacity is up, but only slightly. And it will increase even less this year.

Kenneth W. Brooks
District Editor

THE U. S. REFINING industry is tipping the scales at about the same weight as last year, but it built up some muscles during that time.

As far as construction is concerned, refiners are adding little to basic crude capacity. They are concentrating on programs which will retire old units and replace them with new ones designed to get more of the valuable products from a barrel of crude.

Crude capacity is at an all-time high—it hit 9,789,355 bbl. on January 1—but this is only a 1.8% gain over the previous year. However, refiners have no need to beef up their crude capacity. They are rocking along with plenty of spare capacity. In 1959, refiners operated at approximately 82% of capacity, which leaves plenty of leeway for any increases in demand.

Here's a look at the over-all U. S. refining picture:

. . . **Crude capacity** increased 174,000 bbl. or 1.8% in 1959. Based on new construction, crude capacity will inch upwards a scant 0.6% during 1960.

. . . **Hydrogen treating** capacity soared to 1,941,390 bbl. per day during the past year to top catalytic reforming for the first time. The 13.3% increase, coupled with this year's gains, are expected to shove the nation's total above 2 million barrels per day. This important process for improving feedstocks now accounts for 19.8% of all crude processed.

. . . **Catalytic reforming** posted a 3.5% gain during 1959 with the addition of 64,000 bbl. per day capacity. The forecast calls for another 3% increase next year with a 57,000-bbl. increase now on the drawing boards.

. . . **Catalytic cracking** moved up 231,000 bbl. per day during 1959, for and increase of 5.7%. A gain of about 100,000 bbl. per day is on the books for this year. And the ratio of total feed to crude capacity is inching upward. It now stands at 46.3% compared to 45% last year.

. . . **Thermal capacity** is tumbling. New cokers will be added this year as refiners seek to convert residual stocks, but this probably will not be enough to take up the slack caused by scrapping of other obsolete thermal processes.

. . . **Alkylation** is up 10.1% over last year with an increase of 37,305 bbl. per day. About 14,000 bbl. of new capacity is expected in 1961. The long-term outlook calls for substantial gains in this process.

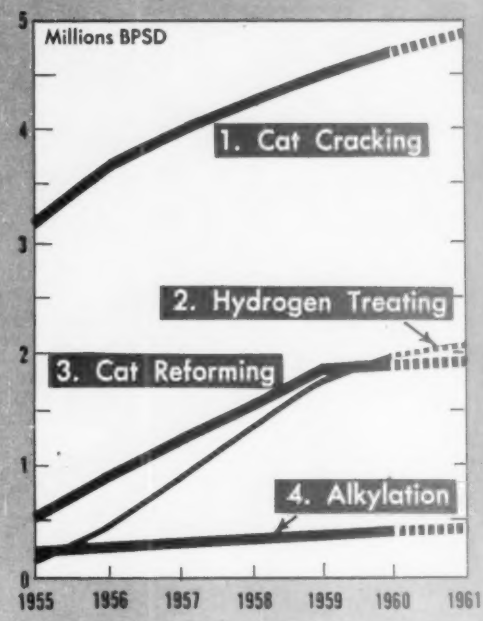
Horoscope . . . During 1959 refiners ran to stills about 82% of their calendar-day capacity.

The unused "cushion" amounted to 1,714,000 bbl. daily, down 57,000 bbl. from 1958. However, some of this cushion represents marginal capacity which will be retired during the next few years.

Refiners are optimistic about the situation and several companies have

The JOURNAL'S Report on

Downstream Processing



1. Cat cracking . . . still growing.

(Feed capacity, BPSD)

Type	1-1-58	1-1-59	% recy.	1-1-60	% recy.	1-1-61 (Est.)
Fluid	3,150,165	3,482,570	22.9	3,697,975	26.5	3,762,480
T. C. C.	764,600	741,900	31.6	755,580	30.3	789,580
Houdriflow	249,800	255,400	13.2	255,360	31.9	255,360
Houdry F. B.	68,800	76,300	19.5	76,755	33.0	76,755
Cycloversion	12,350	11,690	. . .	13,560	. . .	13,560
Total	4,246,165	4,567,860	23.3	4,799,230	29.2	4,897,735

3. Cat reforming . . . up slightly.

(Feed Capacity, BPSD)

	1-1-58	1-1-59	1-1-60	(Est.) 1-1-61
Platforming	714,640	907,835	988,400	1,026,620
Ultraforming	201,590	247,390	247,990	249,190
Sinclair-Baker	93,700	145,400	152,300	171,050
Houdriforming	120,210	139,560	140,415	140,415
Mobil	119,600	123,400	126,935	126,935
Powerforming	32,500	67,500	64,500	64,500
Fluid Hydroforming	62,000	62,600	60,800	60,800
Catforming	59,150	55,600	55,500	55,500
Rexforming	30,500	26,200	17,000	17,000
F. B. Hydroforming	33,000	19,000	5,000	5,000
Misc.	66,200	54,400	53,000	53,000
Total	1,533,090	1,848,885	1,912,840	1,970,010

construction plans on the books which will be announced later this year. If this construction program is not overdone, the end of 1961 or early 1962 should find the industry with a workable balance of capacity.

Octanes rising . . . Catalytic reforming is growing, but not at the rate it has in years past.

Although premium is up 0.3 RON and regular is up 0.7 RON from a year ago, refiners have made these increases primarily with existing facilities. The cat reformer is one of the refiner's most versatile tools. Octane gains are now being realized by operating them at higher severity, and by upping the TEL content over that of a year ago. Little of this increase came from adding new downstream processing capacity.

The long-term outlook calls for higher compression ratios and consequent higher octanes. With its high road-octane characteristics, motor alkylate seems destined to continue its growth for the next few years, although its rate of increase may decline.

The HF process is getting increased interest. Out of a 37,305 bbl. per day increase in capacity last year, HF cornered 44% of the total, but it accounts for only 23% of the nation's over-all capacity.

Middle distillates . . . Refiners are taking a close look at processes designed to upgrade middle distillates and increase gasoline yields as the ratio of gasoline per barrel of crude continues to increase.

This trend is evident by the continued interest in coking. Refiners have been and are continuing to add coking capacity in an effort to cut back fuel-oil production and increase gasoline's share of the over-all refinery yield.

At least two companies are experimenting with residual cat cracking and several hydrocracking processes have been announced recently which could make upgrading of middle distillates attractive.

Stiff competition in middle-distillate quality is forcing many refiners to add hydrogen-treating capacity. In the past year middle-distillate treating accounted for 38% of all new capacity, whereas its share of the nation's total capacity is only 25%. Cracked naphtha and cracker feed are being treated in increasing amounts as well as cat recycle, solvent naphtha, and lube oils. However, no trend can be established here yet.

Isomerization . . . Two butane isomerization units were put on stream this year pushing product capacity above 26,000 bbl. per day for 12 plants. As alkylation grows, refiners will need to add more units to increase their supply of isobutane, and more capacity is on the way. Construction slated for 1960 will add 1,900 bbl. per day.

One pentane isomerization unit came on stream this year, but no new contracts were let. The basic survey reports only two such units. However, one company has a C_5 unit in operation at a gasoline plant which is closely tied to its refining facilities.

Polymerization . . . Capacity is up again after declining last year, and two units are slated for 1960 completion. The new plants will make propylene tetramer, a raw material for the manufacturer of detergents. Most refiners, however, are still operating their units on day-to-day basis for octane balance.

Cat recycle . . . Figures reported this year show a large jump in recycle rate.

Based on total feed, the number now stands at almost 42%. This is misleading. Although some companies do not report recycle capacity, the number that do report it increases from year to year. The large increase reported this year is due both to the increase in the number of responses and the capacity that the respondents control, rather than a significant increase in recycle ratio.

Independents down . . . Ohio Oil Co.

2. Hydrogen treating . . . made a big gain last year.

By process type (BPSD)	1-1-57	1-1-58	1-1-59	1-1-60	1-1-61 (Est.)
Unifining	364,405	498,605	641,505	696,595	770,815
Hydrofining (Ind.)	124,700	187,600	216,100	218,100	219,300
Hydrofining (Esso)	133,300	164,900	165,700	187,100	198,420
Mobil	67,300	99,260	149,900	142,195	142,195
Shell	49,600	70,700	104,900	140,500	140,500
Sinclair	27,000	87,500	99,000	125,000	125,000
Hydrobon	.....	.....	55,000	119,000	119,000
Gulfining	50,000	100,000	100,000	100,000	100,000
Ashland	.....	.....	30,000	32,500	32,500
Kellogg	3,000	20,000	20,000	20,000	20,000
Houdry	13,500	13,960	22,110	14,650	14,650
Misc.	46,150	100,200	109,200	145,750	155,750
Total	878,955	1,342,725	1,713,415	1,941,390	2,038,130

Type of feed	BPSD
Naphtha	1,329,070
Mid. Dist.	469,055
Cracked Naph.	35,065
Cat. Feed	26,300
Cat. Recycle	9,500
Solvent Naph.	9,600
Lubes	13,300
Other	49,500

4. Alkylation . . . growing fast.

(Product capacity, BPSD)

	Sulf.	HF	Total
1-1-56	197,869	65,540	263,409
1-1-57	212,659	59,960	272,619
1-1-58	244,615	65,750	310,356
1-1-59	290,400	79,720	370,120
% crude	2.85	0.79	3.64
1-1-60	311,280	96,145	407,425
% crude	3.01	0.93	3.94
1-1-61 (Est.)	324,240	103,810	428,050

5. Isomerization . . . small gain.

Type	No. units 1-1-60	Product capacity, BPSD 1-1-60	Construction 1960	Product capacity, BPSD 1-1-61 (Est.)
Butane	12	26,240	1,900	28,140
Pentane and heavier	3	24,630	None	24,630

O&GJ

has boosted the number of companies processing over 100,000 bbl. per day to 21 following its merger with Aurora Gasoline Co.

With this addition the majors have increased their crude charging capacity to nearly 8 million barrels per calendar day. This is 81.2% of the U. S. total, up 1.2% from 1958. Taking only the top 20 into account, however, the majors boosted their share of the nation's total only 0.6%—the same as the independents.

Competition has sliced the independent ranks with shutdowns and continued mergers. There were 146 companies who reported operating capacity this year, compared to 155 in 1959. But the majors have been hurt too. Gulf Oil Corp.'s plant in Staten Island was the latest to close. Additions to capacity have more than offset the shutdowns, however.

Three companies plan to bring new refineries on stream this year. By far the largest will be Standard Oil Co. of California's 32,000 bbl. per day plant in Honolulu. In addition, U. P. Oil Refinery, Inc., plans a 1,500-bbl. plant in Rapid River, Mich., and Debco Corp. of Texas has slated a 525-bbl. plant in Abilene, Tex.

The position of the independents with respect to product quality is a strong one. For instance, hydrogen-treating capacity is equal to 18.2% of crude capacity. The same ratio for the majors is 18.9%. Alkylation is gaining widesperad acceptance among the independents. Construction plans this year call for and 11,000-bbl. increase in capacity.

The ratio of cat-cracking capacity to crude capacity appears to lag among the independents, but their position is better than the figures indicate. Some plants have no distillate production, but they account for about 475,000 bbl. of charging capacity. When this number is taken into account the independents compete favorably.

Canadian picture . . . While the U. S. refining industry is going slow on building, the Canadian refining industry is expanding at a record clip.

The modest 26,000-bbl. per day gain in 1959 will be tripled this year when the current building boom is completed. Three new refineries are due

The JOURNAL'S Forecast of Canadian Refining

	Crude		Feed, BPSD					Product, BPSD	
	BPCD	BPSD	Vacuum	Thermal Cracking	Catalytic Cracking	Cat Reforming	Hydrogen Treating	Alkylation	Polymerization
Capacity									
Jan. 1, 1959	818,230	868,160	315,520	145,555	388,960	147,045	130,970	4,920	16,045
Jan. 1, 1960	844,830	920,020	332,430	90,680	382,060	150,610	183,395	5,570	18,215
Jan. 1, 1961 (Estimated)	921,230	1,002,340	379,010	90,680	404,060	169,670	214,395	12,290	19,515
Construction									
1960	76,400	82,320	46,580	0	22,000	19,060	31,000	6,720	1,300

How the Majors and Independents Stand

	Companies controlling over 100,000 bbl. daily capacity			Companies controlling less than 100,000 bbl. daily capacity		
	1-1-59	1-1-60	1-1-61*	1-1-59	1-1-60	1-1-61*
	(Capacities in 1,000 BPSD except where noted)†					
No. Companies	20	21	21	151	146	148
No. Refineries	118	125	126	174	169	171
Capacity, BPCD	7,729.3	7,996.1	8,040.3	1,886.5	1,793.3	1,811.8
Capacity, BPSD	8,117.9	8,413.6	8,464.0	2,036.3	1,947.3	1,967.0
Annual change, %	+0.4	+3.6	+0.6	+0.7	−4.4	+1.0
% of U. S. Total	80.0	81.2	81.1	20.0	18.8	18.9
Cat. Cracking	3,816.8	4,106.1	4,155.4	751.1	693.1	742.3
% on Crude	47.0	48.8	49.1	37.0	35.6	37.7
Cat. Reforming	1,524.4	1,615.2	1,668.6	329.0	297.6	301.4
% on Crude	18.8	19.2	19.7	16.2	15.3	15.3
Hydro. Treating	1,502.3	1,591.8	1,680.5	212.3	349.6	357.6
% on Crude	18.5	18.9	19.9	10.4	18.2	18.2
Alkylation	323.8	358.5	360.5	46.3	48.9	60.4
% on Crude	4.0	4.3	4.3	2.3	2.5	3.1

*Estimate based on new construction slated for 1960 completion only. †Includes plants charging whole crude only.

Refiners With Over 100,000 Bbl. Capacity

Rank	No. Refineries	Capacity (BPCD)
1. Humble	8	962,240
2. Texaco	14	735,000
3. Standard (Ind.)	12	713,700
4. Mobil	12	705,200
5. Standard (Calif.)	11	640,600
6. Shell	6	594,000
7. Gulf	5	532,240
8. Sinclair	6	464,000
9. Cities Service	4	292,300
10. Tidewater	3	279,750
11. Phillips	6	272,300
12. Sun	2	255,000
13. Atlantic	2	210,000
14. Continental	7	190,600
15. Union	6	188,800
16. Pure	4	183,800
17. Sunray	3	180,300
18. Standard (Ohio)	4	170,500
19. Richfield	1	165,000
20. Ashland	5	153,500
21. Ohio	4	107,300

on stream, and other smaller additions to capacity are planned at existing plants.

The big spurt will hike the nation's refining capacity close to the million-barrel mark and contribute to an existing oversupply problem in Eastern Canada.

The current survey of the industry shows calendar-day capacity at 844,830 bbl. on January 1. Construction plans now on the books will increase this number by 9% to 921,000 bbl. per day.

The big reason for the increase will be the completion of two major plants in the eastern provinces.

BP Canada, Ltd., will put its $30-million, 22,500-bbl. plant on stream at Ville d'Anjou, Que. And Irving Refining, Ltd., will complete its 38,000-bbl. plant at St. John, N. B. The Irving plant will cost between $45 million and $50 million.

A third new plant is also under way. Canadian Oil Companies, Ltd., is building an 1,800 bbl. per day refinery in the Innisfail area, Alberta.

Although capacity will soar during the coming year, no major projects have been announced for 1961. And the rash of expansion which has marked the Canadian industry for the past several years should begin to taper off.

Product quality . . . Canadian refiners continue to place emphasis on downstream processing. This year, for the first time, the industry surpasses the U. S. in the percentage of the crude barrel which is hydrogen-treated. The ratio is 20% in Canada compared to 18.7% in the U. S.

Canadians lag in other downstream processes, but not far. U. S. cat cracking capacity now accounts for 45.5% of crude capacity. In Canada the same ratio is 41.5%. Cat reforming is equal to about 18% of U. S. capacity, while in Canada it's 16.4%. Alkylation accounts for only 0.6% of the Canadian crude barrel, but this process is beginning to move. At the current construction rate this figure will double during 1960. In the U. S. alkylation is pushing toward 4% of over-all crude capacity.

Oversupply . . . The Canadian's chief concern is still oversupply, particularly in the Atlantic provinces where the two major refineries are due on stream this year.

Like the U. S., Canada has been caught in a postwar building boom which has outstripped the increase in demand. The long-term outlook is bright. But for the time being, the market place is a little crowded.

About the Journal Survey

FIGURES in this report are based on plant-by-plant capacity data given to the Journal by operating refiners. The detailed survey, which is the only one of its kind, begins on page 149.

This survey includes all facilities which were in operation at the first of this year. It is restricted to plants charging whole crude oil. An appendix lists specialty plants processing petroleum or related fractions to produce asphalt, lubes, waxes, and fuels.

It is recognized that a survey of refineries does not include all sources of gasoline. Numerous field processing plants produce blends or finished motor fuel, but are not included because they are not classed as refineries.

Except where designated, all figures in the Journal survey are expressed in barrels per stream day. In a few cases only calendar-day capacity is reported to us. Such figures are identified and published as reported in the basic survey. To arrive at consistent totals, calendar-day figures are converted to a stream-day basis. They are divided by 0.95 in the case of crude and vacuum units and 0.90 in other processes.

The Journal does not attempt to pinpoint forecasts of capacity. But it does include a listing of all new construction planned at the first of the year. These net additions to capacity have proved reasonably accurate in projecting over a 1-year period. But they do not take into account upgrading, removal of bottlenecks, the unscheduled shutdown, retirement, or downgrading of capacity which may occur during 1960.

Wage-Hour Bills May Affect Marketers

• The legislation can still be changed, but one of the basic objectives is to extend coverage. If service-station employes are covered, owners' profits would be pared by overtime pay for more than 40 hours work.

THERE is considerable concern in marketing circles over the possible passage of legislation this year to increase minimum wages and extend coverage of the wage-hour laws.

The concern stems from the likelihood that the extended coverage would include many jobbers and service-station operators who heretofore have been excluded from the provisions of the wage-hour laws.

Because the legislation is still subject to amendment in both the House and the Senate, there is some uncertainty over the final form it may take. Basically, however, the legislation is aimed at increasing minimum wages on a graduated basis to $1.25 an hour, and extending the coverage to include many establishments which have not been covered previously.

Marketers for the most part are not greatly concerned over the wage minimum, since most service-station employes are paid that much or more now. But the effect of overtime pay could be considerable.

Currently, many service-station employes are on a 48-hour week, drawing straight time for all 48 hours. But if the wage-hour coverage is extended to include them, they would get time-and-a-half pay for all hours over 40.

The net effect could very well be an increase in the cost of service-station operation, resulting in reduced profits for the operator or an increase in the price of gasoline.

Definitions not firm . . . The extent of coverage still hinges on clarification of definitions and agreement on the size of establishments to be covered.

Proposals on size have ranged from enterprises with sales of $500,000 or more annually, to firms whose sales exceed $1 million and who employ 100 persons or more. As amended by a subcommittee, the bill in the Senate proposes a compromise figure of $750,000 in annual sales.

Even more important will be the final definition of the term "enterprise."

It seems certain that if a person or a firm operates more than one service station, the sales from all these outlets will be lumped together in determining whether the sales of the "enterprise" reach the minimum or not.

Clearly, then, chain stations and company-operated stations would fall within the coverage.

There are some lawyers who point out that the definition could easily be interpreted to include lessee stations. Such a definition would be based on the thesis that since the supplier "controls" the leased station, the sales at that station would be included in the supplier's sales totals. Thus, even a small station with two or three employes could fall under the extended coverage.

Furthermore, aside from such interpretations, present terms of the bill include a provision that all retailers not coming under the general coverage would be required to pay a minimum wage of $1 an hour, starting 18 months after the bill becomes law.

Hearings on the legislation, introduced in the Senate by Senator Jack Kennedy (D.-Mass.), were held last year by a labor subcommittee. It is now before the full labor committee. Hearings on a similar version, introduced in the House by Rep. James Roosevelt (D.-Calif.), were started recently.

Washington observers are generally of the opinion that the wage-hour legislation stands a fair chance of passage during the current session. It would be, they say, an election year effort to mollify labor leaders who were enraged last year by the passage of the Landrum-Griffin bill, which they considered anti-labor legislation.

Dry Georgia Whets the Interest of Oil Hunters

• Acreage is being leased along the coastal plain and two wells will be spudded soon in the southwest part of the state by independents.

GEORGIA has never produced any commercial oil, but several people and companies soon may be giving the state another chance.

Interest centers in two regions—the Atlantic coastal plain and the southwest.

Humble Oil & Refining Co. has acquired a half-million acres, mostly in the coastal area and has drilled some 200 shallow core holes.

The company last week was tight-lipped about its drilling program and would say only that it is "still accumulating additional information."

To date, however, Humble has taken out no drilling permit from the Georgia Department of Mines and Mining.

Meanwhile, another group has been busy leasing acreage along the coastal plain with the expectation of sinking more than a score of tests.

Roderick A. Stamey, Houston geologist and consultant, is acting for a group of Houston investors in acquiring acreage. So far the group has about 20,000 acres under lease and expects to get several times that amount. The target spudding date, at least for now, is July.

Most of the leases are in Bryan, Chatham, and Effingham counties near Savannah and the southern tip of South Carolina.

In southwestern Georgia two drilling operations are about to start.

Ernest Hill, Houston independent, expects to spud this week a well about 8 miles northwest of Americus (OGJ, Feb. 1, p. 67). Hill and his associates hold about 10,000 acres in four blocks in the area.

J. R. (Bob) Sealey, Cottonwood, Ala., has taken out a permit to drill his fifth Georgia well in the southwestern tip of the state next to Florida and Alabama. He has tried twice in Decatur County and twice in Seminole County.

The new well will be located 18 miles west of Bainbridge in Seminole County.

If one of the tests planned finds oil, there should be a quick payout on the well. Georgia has a standing bonus of $250,000 for the first 100-bbl. well.

Exploratory Drilling Decline Halted

• AAPG's annual report shows the number of wells during 1959 totaled almost the same as the previous year, while total footage increased sharply.

EXPLORATORY drilling in the United States almost held its own last year. And the success ratio was up a bit.

The 1959 score shows 13,191 exploratory holes and a total footage of 63,252,521 ft., or an average of 4,795 ft. per hole. This is a drop of only eight wells from 1958, and a sharp increase of 1,768,610 ft. of hole. The average depth per hole represented an increase of 134 ft. over 1958.

The over-all success ratio in 1959 was 19.83%, compared to 19.46% the year before. Of the footage drilled, 23.07% was successful, with 1 producer foot being drilled for every 3.33 ft. of dry hole. One successful well was drilled for every 4.04 dry holes.

These encouragements are reflected in the report of the American Association of Petroleum Geologists committee on statistics of exploratory drilling. This study is an annual project and a major contribution to industry statistics. It will be submitted next month before the business committee at the AAPG annual convention in Atlantic City.

B. W. Blanpied is serving his third term as chairman of the reporting committee. He is a geological consultant for Gulf Oil Corp.

The hazards faced by the wildcatter are clearly apparent from a study of the exploratory drilling report. Of the 13,191 holes drilled last year, only 2,614 were successful. The other 10,577 were dry holes.

The geologists who made this study also looked into the reasons for drilling each new-field wildcat (such wildcats are only one type of exploratory well included in this annual tabulation). This year's study shows that 5,947 new-field wildcats were drilled on technical advice. Of these, 705 were hits and 5,242 were failures.

Of 526 wells located on nontechnical basis, 32 produced and 494 failed. The figures show that 12.06% of the wildcats drilled on technical advice were producers, in contrast to 6.18% of those drilled without such advice.

A State-by-State Rundown on Exploratory Drilling in 1959

	Oil Producers		Gas Producers		Cond. Producers		Dry Holes		Grand Totals		Average Depth*
	Number	Footage	Number	Footage	Number	Footage	Number	Footage	Number	Footage	
Alabama	0	0	0	0	0	0	30	126,175	**30**	**126,175**	4,206
Alaska	3	30,846	3	25,867	0	0	7	75,802	**13**	**132,515**	
Arizona	1	6,080	1	6,787	0	0	21	61,597	**23**	**74,464**	3,238
Arkansas	23	91,351	27	129,390	0	0	164	661,287	**214**	**882,028**	4,122
California	55	397,039	27	128,310	0	0	411	2,247,397	**493**	**2,772,746**	5,624
Colorado	34	180,500	21	128,073	0	0	398	2,077,344	**453**	**2,385,917**	5,267
Florida	0	0	0	0	0	0	11	80,807	**11**	**80,807**	
Georgia	0	0	0	0	0	0	2	10,406	**2**	**10,406**	
Illinois	58	56,822	4	4,499	0	0	527	927,967	**589**	**989,288**	1,680
Indiana	59	77,553	3	5,895	0	0	392	594,491	**454**	**677,939**	1,493
Iowa	0	0	0	0	0	0	1	2,236	**1**	**2,236**	
Kansas	285	967,849	59	252,215	0	0	1,301	4,665,855	**1,645**	**5,885,919**	3,578
Kentucky	30	43,883	15	40,281	0	0	295	418,982	**340**	**503,146**	1,480
Louisiana	139	1,321,440	22	231,363	123	1,447,176	786	7,288,442	**1,070**	**10,288,421**	9,615
Michigan	10	36,759	6	18,086	0	0	170	570,090	**186**	**624,935**	3,360
Mississippi	29	236,592	9	78,418	0	0	251	2,236,935	**289**	**2,551,945**	8,830
Missouri	2	3,590	0	0	0	0	17	14,681	**19**	**18,271**	
Montana	7	32,120	4	14,333	0	0	101	491,424	**112**	**537,967**	4,803
Nebraska	53	319,696	1	65	0	0	393	2,305,972	**447**	**2,625,733**	5,874
Nevada	0	0	0	0	0	0	1	8,521	**1**	**8,521**	
New Mexico	83	426,765	54	276,568	3	22,048	301	1,181,378	**441**	**1,906,759**	4,324
New York	0	0	10	26,010	1	3,200	28	106,287	**39**	**135,497**	3,474
North Carolina	0	0	0	0	0	0	11	17,507	**11**	**17,507**	
North Dakota	41	249,442	0	0	0	0	92	508,826	**133**	**758,268**	5,701
Ohio	15	44,011	17	64,672	0	0	52	169,525	**84**	**278,208**	3,312
Oklahoma	143	706,770	92	498,930	3	31,628	843	3,205,584	**1,081**	**4,442,912**	4,110
Oregon	0	0	0	0	0	0	5	9,640	**5**	**9,640**	
Pennsylvania	0	0	7	41,653	0	0	21	110,637	**28**	**152,290**	5,439
South Dakota	3	25,432	0	0	0	0	13	74,683	**16**	**100,115**	
Tennessee	3	4,423	1	1,205	0	0	68	50,977	**72**	**56,605**	786
Texas	588	3,074,835	231	1,252,425	138	1,117,868	3,396	15,781,472	**4,353**	**21,226,600**	4,876
Utah	8	57,788	3	78,703	0	0	88	481,052	**99**	**557,543**	5,631
Washington	0	0	0	0	0	0	5	34,688	**5**	**34,688**	
West Virginia	1	1,333	9	32,235	0	0	11	58,826	**21**	**92,394**	
Wyoming	29	151,963	18	133,277	0	0	364	2,018,876	**411**	**2,304,116**	5,606
TOTAL	**1,702**	**8,544,972**	**644**	**3,409,260**	**268**	**2,621,920**	**10,577**	**48,676,369**	**13,191**	**63,252,521**	**4,795**
Average depth per hole		5,021		5,294		9,783		4,602		4,795	

*Average per-well footage given only where 25 or more wells were drilled in the state.

This means that wildcats drilled on technical recommendations were 1.95 times as successful as those drilled without such advice.

A closer look at the reasons for drilling shows:

... **Geology** was used for 422 producers and 3,711 dry holes.

... **Geophysics** was used for 107 producers and 605 dry holes.

... **Geology and geophysics** combined were used for 176 producers and 926 dry holes.

Sixty-seven producers and 1,017 dry holes were drilled for other reasons.

Western Canada score . . . Canadian drillers had much better luck with their exploration campaigns in 1959 than their U. S. counterparts.

The statistics show that 30.72% of the 905 exploratory holes in Western Canada were successful along with 34% of the exploratory footage. For every producer completed, 2.25 dry holes were finished.

The average Canadian well is also deeper at 4,930 ft. As for strictly new-field wildcatting, Canada also did very well. Of 661 such wells, 144 were hits and 517 were dry. This means a 21.75% success rate for Canadian wildcatters, or almost twice that of the U. S.

Mexico does well . . . To the south, exploratory drilling also did very well.

A total of 133 explorations was drilled, and 42 of these were successful, bringing the score there to 31.55% overall. Total footage drilled

Near Miss Is Hit

A MICHIGAN "dry hole" turned out to be a 30-bbl. per hour discovery.

McClure Oil Co. 1 Hergert in Hillsdale County, a Scipio field offset location, logged Trenton Ordovician at 3,590 ft. after it had been drilled "dry" to 4,179 ft. McClure had shut down the 2 Hergert on the same unit at 1,025 ft. and moved rig off location.

But, following company practice, an electric log was run on the No. 1 hole before plugging. It showed a 20-ft. section in Trenton as favorable. Then operators ran drill-stem test at 3,970 to 4,010 ft. and had gas to surface in 15 minutes and oil in 50 minutes. The well flowed 10 bbl. per hour by heads.

Present theory is the hole missed a dolomite fracture by less than an inch.

was 983,012 ft. and the average well went to a whopping 7,391 ft.

As for new-field wildcatting, Mexico shows 82 such wells, and 11 of these were hits, to score a 13.41% success ratio.

Natural gas . . . This year, for the first time, the AAPG committee is presenting data on natural-gas reserves in a 17-state area.

These reflect only those discoveries having 6 years or more of development history. Therefore, the figures in this year's report cover those fields discovered during the period 1943-1953.

The study shows that after 6 years of development history only 31.7% of fields in the 6-60 billion cubic feet class had pipeline outlets, and only 43.8% of the less than 6 billion cubic feet class had outlets.

"It appears logical to assume that on an average, all fields of these classes should be considered unprofitable, even though they are classified as successful completions," the committee reported.

Going further, the geologists showed that the percentage of unprofitable gas fields to all gas discoveries for the year 1953 was 63.75%, and that for the 11-year period, 53.85% of the gas discoveries were in the unprofitable class.

The full report of the AAPG committee will be published in the association's bulletin next June. Meanwhile, a more detailed extract of the report will appear in the Exploration section of next week's Journal.

Labor Peace Is Likely for

• Oil's labor picture has almost done a flip-flop since last summer. OCAW has lost both on the picket line and at the ballot box and Hoffa has failed in his drive to break into Jersey's refineries.

THERE'S a pretty general feeling that oil is in for a period of labor peace. But it may still be an uneasy era, for the simple reason that labor can't allow such a condition to last indefinitely.

This feeling results in part from two recent events: The defeat of OCAW in the runoff election at Esso's Bayway, N. J., refinery and the sudden ending of the record-breaking strike at Indiana Standard's Sugar Creek, Mo., refinery.

OCAW suffered a severe loss of prestige in both instances.

It led the field in the preliminary election at Bayway in February and was favored to win the March 16 runoff. It didn't. The Independent Petroleum Workers, who trailed in the preliminary 597 to 533, won the runoff 699 to 647.

A victory at Bayway would have given OCAW bargaining rights at two of Jersey Standard's three largest domestic refineries. It had won an election last August at Humble's refinery at Baytown by a vote of 1,621 to 1,196. But now, instead of having two of the big three Jersey refineries, OCAW has a tenuous hold on only one.

The capitulation at Sugar Creek some 10 days earlier was even more humiliating to OCAW. Late the night of March 4 the union gave in after holding out for 241 days without winning a single objective. Not only that but the union lost ground numerically. Sugar Creek's management made it clear that not all workers would necessarily be called back.

Thus, in the short space of 2 weeks, OCAW suffered two body blows. It had to give up on the longest strike it ever promoted, and it lost an important election that looked like a sure-fire bet to win.

A quick change . . . This is in marked contrast with OCAW's position last summer. It never looked better. The union had just knocked over a major target in Humble's big Baytown refinery and was acting very much as though it had American Oil Co. on the ropes at El Dorado and Texas City and Indiana Standard at Sugar Creek.

OCAW may have rated its victory at Baytown more highly than it deserved. Observers there believe the outcome of the election was more an indication of resentment against the independent union's leadership than a demonstration of affection for OCAW.

Top officials of the independent were playing footsie with James Hoffa and the Teamsters International. This association apparently disillusioned the independent union members with their own leadership so they threw in with OCAW.

Then, too, the strikes at El Dorado, Texas City, and Sugar Creek had a far different effect than OCAW had bargained for. Each of the refineries kept right on operating with skeleton crews made up of supervisory personnel. It wasn't easy but the makeshift crews made enough product so that the companies by adopting a variety of resorts managed to get by.

OCAW's timing for a strike couldn't have been worse. The union picked a time when the industry was plagued by oversupply. It was an ideal time to cut back runs. Some companies, not necessarily those directly affected, would have welcomed an excuse to cut runs. The strike certainly deterred Amoco and Indiana from succumbing to the lure of the "incremental barrel" that has proved so generally disastrous. The strikes did hurt but, as events amply proved, they were far from fatal.

These strikes, all starting in July, folded up one by one. El Dorado was first. OCAW capitulated there in November after 134 days. Texas City followed in January after 191 days. Finally came Sugar Creek in March after 241 days.

Many oil-company industrial relations men privately applauded Amoco and Indiana for fighting to uphold management's right to manage. Wages were not an issue. The big question was who—management or the union—would control plant manning policies.

Blow to Hoffa . . . These past few months not only have seen a diminish-

Oil Industry—at Least for a While

ing of OCAW's stature but they also have witnessed an abortive effort on the part of the Teamsters to break into oil-refinery unionism.

The Teamsters, with Hoffa's support, made a real effort to wangle its way into the Jersey chain of refineries.

They made overtures to independent union leaders and won some high placed support in independents' ranks. It wasn't enough, however, to persuade the rank and file.

Sensing defeat at Baytown, the Teamsters withdrew from contention a couple of weeks before the August election. They made their best showing at Esso's Baton Rouge refinery in December when they polled 498 votes against 2,561 for the independent. They went to bat again at Bayway last month and struck out swinging. They polled a bare 136 votes in the preliminary election, about a tenth of the total.

Although losing the preliminary election at Bayway, Teamsters held a "balance of power" in the March runoff. One guess is that the Teamsters encouraged their members to vote for the independent union in the runoff on the theory that an independent would be easier to displace later on than an international union. Therefore, the Teamsters still can be an influential factor at Bayway.

For that matter, Esso can't feel too secure. It was unquestionably happy to see the independent win at Bayway. But the margin was uncomfortably close. The independents' got 52% of the votes, OCAW 48%. A shift of just 27 votes would have upset the apple cart.

Bayway's emphatic turndown of the Teamsters after their losing efforts at Baytown and Baton Rouge makes it clear that they are no immediate threat. However, it would be highly premature to write them off if only because of Hoffa's well-known tenacity.

Seeds of discord . . . There are at least two good reasons why permanent peace in oil is most improbable.

One of these is the presence of many independent unions in the industry. As long as they exist, they will be targets of the major international unions that want to strengthen their position by increasing their membership and plant control. And a way to do this is to knock off the independents.

Another disturbing trend is to loss of ground by the big unions. While the nation's population is growing, union membership is declining. Unless this is reversed, the unions face a diminishing role in the national picture. It's inconceivable that they will accept this trend without trying to stop it. One way to achieve this, at least temporarily, would be to swing more independent unions and presently unorganized groups into national bodies.

Another factor eroding union strength is automation. Control equipment is gradually whittling down the number of workers needed to operate a refinery. Undoubtedly this will continue. This does not necessarily mean widespread layoffs. Many companies, including several whose refineries are independent-union dominated, achieve the payroll savings through attrition. They just don't fill jobs when men leave or retire. This method is slower but more humane than mass discharges.

Decreasing numbers may frighten national unions, but not so leaders of enlightened local groups. The local units realize that the fewer people who are employed to do a given job, the more important their role becomes. As their job increases in importance, so does their value to the company. Their potential earnings also ride this upward trend.

Management outlook . . . The companies will continue to encourage independent unions—and the companies have good reason for this.

Refineries, even within the same company, vary greatly. Probably the greatest important differences are in size and in economy of operation. This means that local problems can be better solved by a union influenced solely by local conditions and not governed by a national policy emanating from Denver.

The advantages are not entirely on the side of the company. An independent union can be better able to act in its own behalf than the local of a national that must conform to a national pattern. This can make an independent union stronger than the local of a king-size union.

Industrial-relations managers, as a whole, don't oppose "strong" unions. Several have said they welcome them. One reason is the ability to get a more clear-cut understanding between management and a strong union. A strong union can and does listen to and talk to management.

Just how long this expected labor peace will last is uncertain. After the defeats OCAW has suffered, it seems unlikely the union will give the industry too much trouble until conditions are more favorable. And the Teamsters appear to carry much less punch than a few months ago.

OCAW's Jack Knight
. . . strikes failed to do the job.

Teamsters' Jimmy Hoffa
. . . his battle cry waning.

Compacts Aren't Living Up to Advance Billing

• Octane requirements show a wide spread and compacts are not doing too well on regular grade gasoline. Mileage is also a weak point. It is doubtful that any of them will get the talked-of 30 miles per gallon in normal use.

THE COMPACT CARS are making big inroads into the new-car market. More than one of evety five new U. S. cars sold is a compact.

But while they're proving popular, they're also proving disappointing in economy and performance.

Right now, their future is a question. But the auto makers themselves are moving quickly to correct some of the obvious faults—low gasoline mileage, tendency to burn up valves, high oil consumption, carburetor icing, and fuel-distribution problems.

Their initial popularity, plus the efforts of manufacturers to improve their product, means the compacts will certainly be big news for the next year or two. After that, no one knows.

Here are some of the problems:

...Fuel requirements. Octane requirements range all over the lot. Some are as low as the high 80's while others are up around 100 RON. A surprisingly large proportion have fuel requirements above 92.3 RON, the current national average for regular.

...Mileage. The compacts are not giving the miles-per-gallon that buyers were led to expect. Figures as low as 14 miles per gallon in city driving and under 20 on the open road have been encountered. This is far below what economy imports will do.

...Economy. U. S. compacts have more pickup and power than the economy imports. But their comparatively low mileage and relatively high fuel requirements give the foreign cars a big edge in operating economy.

What will the public eventually settle on? Some think that cars comparable to the Dodge Dart are closer to the answer than the compacts. Dart's 145 hp. gives performance. Its 8.5:1 compression ratio puts it in the regular-gasoline category. Its weight-to-horsepower is a good 10% better than the average compact. And it's roomier.

Compacts have one unquestioned advantage: They are compact. They are about 2½ ft. shorter and about 1,000 lb. lighter than standard six-cylinder cars. It makes them easier to handle and they are less vulnerable to body damage. But that's not all.

How compact specifications compare

Make	Comp. Ratio	Hp.	Length	Weight	Wt./Hp. Ratio
Compacts:					
Valiant	8.5	101	184.0	2,655	24.3
Corvair	8.0	80	180.0	2,305	28.8
Falcon	8.7	90	181.2	2,288	25.4
Rambler	8.7	127	189.5	2,948	21.6
Lark	8.3	90	175.0	2,619	29.1
Average	8.44	97.6	181.9	2,563	26.3
Standard Sixes:					
Chevrolet	8.25	135	210.8	3,560	26.3
Ford	8.4	145	213.7	3,562	24.6
Plymouth	8.5	145	209.4	3,370	23.2
Average	8.38	141.7	211.3	3,497	24.7
Intermediates:					
Dart	8.5	145	208.6	3,430	23.6
Comet	8.7	90	194.9	2,495	27.7
Average	8.6	117.5	201.8	2,963	25.2

Fuel requirements . . . The compacts have surprised almost everyone with their fuel requirements. Because of their low average compression ratio, it was generally believed that they would do well on regular grade fuel. It hasn't turned out that way.

Few companies have had time to make large-scale tests on compacts yet. However, results from a score or more of such tests show octane needs ranging from a low of 87 RON to a high of 100.2 RON. A simple average of these tests is above the national average for regular. As one engineer puts it, "The compacts are pushing regular pretty hard."

It's not unusual for cars of the same make and model to vary widely in fuel requirements. They can range 10 numbers. Therefore, the great disparity in the fuel needs of the compacts is not distinctive with them. It is, however, putting an appreciable portion of them in a higher than expected category.

Compacts should fare pretty well on regular in the northeast and upper midwest where it averages around 93.5 RON. However, in the south, where regular averages 90.5 RON, and on the West Coast, where it averages only 91 RON, more complaints on their inability to function satisfactorily on regular can be expected.

Compacts with automatic transmissions have, on the average, lower fuel requirements than those with manual transmissions. A possible reason is driver handling . . . inept manual shifting puts more stress on fuel than automatic. Generally, automatic transmissions are outselling manuals, especially in the case of the Corvair.

Mileage . . . No compact is living up to advance claims for mileage. It's doubtful that any of them will get the talked-of 30 miles per gallon except under ideal conditions.

It's significant that in the last Mobil Economy Run, four standard sixes ran close behind two compacts on mileage. Two Ford sixes averaged 20.32 and 19.92 m.p.g., and two Chevrolet sixes, 22.37 and 21.94 m.p.g. The Rambler averaged 22.95 and the Lark, 22.44 m.p.g.

A research executive with a major oil company actually said this: "We have found the mileage results with the compacts so poor that we would prefer not to say anything about them for publication."

Another says the best that can be expected is 25 m.p.g. on the open road and less than 20 in city driving. This company's limited experience indicated that the established compacts, Rambler and Lark, and especially the former, got the best mileage. It rated Falcon a shade better than Corvair

and Valiant. Corvair's mileage is hurt by its gasoline heater. The heater burns enough gasoline to knock 1 to 2 miles from its miles-per-gallon average.

Economy . . . Low mileage and relatively high fuel requirements hurt the compacts in their claims for economy. Too, the fact that they cost much more than imports deprives them of another. Thus, they lose out on two important counts to imports: Operating cost and initial cost.

The standard cars stack up pretty well against the compacts. They are longer and heavier, but their higher horsepower gives them much better performance qualities. The standard sixes' average compression ratio is a shade lower than the average for the compacts so that, on the average, they should be satisfied with a shade lower octane quality.

Wt./hp. ratio . . . Looking at them from the standpoint of weight to horsepower ratio, the compacts, as a group, rate more poorly than either the standard sixes or what might be called the intermediates.

The compacts average 26.3 lb. per horsepower against 24.7 lb. for the standard sixes and 25.2 lb. for the so-called intermediates.

Rambler's six has the best. It's 9½ inches longer than an average of the other compacts and 480 lb. heavier. Its 127 hp. compares with an average of 90 for the others. Despite its greater weight, its much higher horsepower gives it a 21.6 ratio, the best of the 10 cars in the compact-intermediate-standard six field.

Plymouth and the Dodge Dart are close behind Rambler in this regard. The weight/horsepower ratio of the former is 23.3 and the latter, 23.6. Comet, Ford's coming entry in the intermediate field, will be more than a foot shorter than the Dart and almost 1,000 lb. lighter. But its low horsepower, 90, puts it high up in the weight/horsepower category.

Compacts Chosen

COLUMBIA Gas System plans to convert its "low-priced" fleet entirely to compact cars and expects, eventually, to save as much as $125,000 per year on the deal.

It will gradually replace its fleet of 800 cars with compacts and will complete the program in about 4 years.

Columbia compared the compacts to foreign cars and decided on the latter because of power, automatic transmission, capacity, clearance, and comfort. They will be used in all types of service from exploration to business promotion.

What's being done . . . Manufacturers are moving to bring the compacts completely into the economy field.

One, whose compact had a high fuel requirement, is reported to have knocked off about 0.4 of a compression ratio to cut down its requirement.

Another which was troubled severely with carburetor icing has made changes to correct this problem.

One has changed its distributor and altered distributor timing to reduce fuel requirements. This manufacturer is said to be shooting at a maximum requirement of 91.5 RON for all its economy cars.

Fuel distribution problems are showing up in some of the compacts. This could improve the chances for tetramethyl lead as a gasoline additive.

One of the compacts that claims a unique engine device is reported to be having serious oil consumption problems.

Still another problem peculiar to just one of the new compacts is a tendency to chew up valves.

Despite these shortcomings, many automotive engineers in the oil industry think that Detroit did a good job on the first crop of compacts. The speed with which manufacturers are moving to correct defects guarantees a continuing battle with both the standard models and imports.

But even with these changes, the role of the compacts is still a question. They have certainly not cut deeply into imports. They are not competitive on initial or operating costs.

They have not hurt the one medium priced car to come out with an "intermediate." That's Dodge's Dart. Dodge sales, largely the Dart, were up this February a whopping 270% over February 1959.

Manufacturers of most of the compacts are offering power-pack options, thereby indicating that all buyers are not satisfied with the performance of the compact as it is. And all are talking of smaller versions of the medium-priced cars.

Just where Detroit will finally end up is still uncertain. But two trends will almost certainly continue: Those toward fewer cylinders and toward lower fuel requirements.

Two years ago 80% of U. S. cars had 8-cylinder engines. This year the figure will be around 50%. Two years ago about half of the new cars were satisfied with regular. This year, close to 75% of new cars will be in this category.

As far as the oil industry is concerned it will mean a gradually increasing demand for regular and a better quality of regular, at least in some portions of the country.

INDUSTRY BRIEFS . . .

Proposed merger of Texas National Petroleum Co. and Petro-Minerals, Inc., both of Houston, will be voted on by shareowners of the two companies April 5. If approved, Texas National will exchange one share of common stock for four shares of Petro-Minerals. Both companies are oil and gas producers. Reported net earnings in 1958 were $313,478 for Texas National and $61,644 for Petro-Minerals.

Two recently completed deals give the Saskatchewan Power Corp. full ownership of the Many Islands Lake gas field in southeastern Alberta. The corporation, owned by the Province of Saskatchewan, gave $10,000,000 for Britalta Petroleums' 50% interest in the field. On March 24, sale of Crescent Petroleum Corp.'s half interest to Saskatchewan for $15,200,000 was finalized by the Alberta Conservation Board. The field covers 152,000 acres and has estimated reserves in excess of 800 billion cubic feet of gas.

Esso Research & Engineering Co. has developed a new synthetic jet airplane lube oil that will not deteriorate in tropical or arctic climates for 5 or more years. The new fuel now is being supplied the U. S. Air Force, Esso announced.

The April production allowable for southeastern New Mexico has been fixed at 35 bbl. a day by the New Mexico Oil Conservation Commission. This compares with 36 bbl. for March. The April allowable for the San Juan basin remains 60 bbl. daily.

The deepest producer in Arkansas has been brought in by Austral Oil Co., and Olin Gas Transmission Corp. It is a gas and condensate well producing from perforations at 11,004-025 ft. It is 4 miles southeast of Bradley in Lafayette County (34-19s-24w).

Growth of Oil's Radio Systems May Be Stunted

• The industry, which has made radio an essential element in all of its operations, will need more stations as automation increases. But use of radio by others is also rising and available stations are shrinking.

THE MOST SERIOUS challenge to the petroleum industry's continuing effective use of radio is the growing competition for radio channels.

Because of this, a National Petroleum Council committee is urging the industry to help alert the public government agencies, and Congress itself to the importance of adequate spectrum space for use by the industry.

The NPC study group, the Committee on the Use of Radio and Radar, made its report to the council at a meeting in Washington. The council unanimously adopted the committee's report.

The committee pointed out that the oil and natural-gas industry has adopted radio to a far greater extent than most persons realize, and that radio is an essential element of all of the industry's operations. In fact, the committee made it clear that oil, more than any other industry, is highly dependent on radio usage.

The danger for the future lies in the fact that other uses of radio are increasing. As a result of this "battle of the spectrum," oil's use is limited by the air space made available to it.

Effect of automation . . . The report also calls attention to the role communications facilities play in the industry's increasing use of automation.

"With inevitable increases in costs of many petroleum industry activities," the committee said, "it is obvious that to remain competitive, more efficient, precise, and economical methods of operations in all phases of the industry must be found.

"More rapid data collection and processing, more accurate forecasts, more rapid decisions, and greater flexibility of utilization of equipment are essential," the report continued. "The results are already apparent in pipelines, refineries, and even oil and gas field operations."

The committee said that growth in scope and importance of automation will demand more and better communication facilities.

The committee's report outlines the history of the industry's use of radio, and the part radio has played and is playing in exploration, drilling and production, pipeline operation, refinery operations, marine transportation, and offshore.

The report discloses that 736 oil industry firms utilize 44,117 VHF radio transmitters and that gas distributors use an additional 17,757 to bring the industry's over-all total to 61,874 transmitters.

There is a total of 1,116 microwave stations, including those under construction, in petroleum radio service and an additional 91 stations in use by natural-gas distributors. The industry total, therefore, is 1,207 stations with a combined mileage of 26,753 miles.

The committee also called attention to the common carrier problem. The common carriers believe they should have the sole right to fill all communication needs. The petroleum industry's position has been that there is a proper field for communications common carriers but also a place for private communications systems.

"Neither should preempt the entire field," the committee said. "The user should have freedom of choice in most instances, for only he has both the knowledge and incentive to make the proper choice."

The detailed report, including eight basic recommendations it offers, may be obtained from the National Petroleum Council, 1625 K Street, N. W., Washington 6, D. C.

AOSC Aims to Eliminate Any Shady Dealings

• A code of ethics with teeth in it has been adopted by the association and members must swear to conduct their business within this framework.

THE ASSOCIATION of Oilwell Servicing Contractors has adopted a code of ethics and enforcement machinery designed to eliminate any shady dealers—a major thorn in the side of the association and the servicing industry.

Directors of the association approved the code at a recent meeting in Dallas.

As a condition of membership in the association, a service contractor must swear to follow the code. In doing so, he pledges to refrain from offering or accepting kickbacks, bribes, or gratuities which directly or indirectly modify his published price schedules. He also swears that he will not charge his customers for work not performed or materials not furnished; will not falsify records; and will make his records available for inspection by the association and his customers.

Breach of the code will be subject to disciplinary action by the association, with the maximum penalty calling for expulsion from the association and publication of such expulsion in the AOSC monthly magazine.

Enforcement provisions call for an AOSC grievance-committee system which will act on state and national levels.

Three-man grievance committees will be formed in each state. Each state represented in AOSC will have one committee with the exception of Texas, which will have three—one for South Texas-Gulf Coast, one for East and North Texas, and one for West Texas.

The state committees will act as arbitrators where possible in disputes between contractors. They will investigate disputes between contractor and operator and check into any reported unethical practice by an AOSC member.

The state groups are empowered to issue reprimands for minor violations of the code.

Any major violation, however, or disregard of state-level reprimands will be investigated and reported to a national grievance committee.

The national committee will have one regularly scheduled meeting a year. It will hold this session the day before the association's annual meeting to act on reports from the state groups and to hear any defense which a charged member might wish to present. However, when it wants to, the national committee may hold special meetings.

LPG Rail Rate Cut

. . . proposed in attempt to undermine Katy pipeline.

ON THE EVE of financing of the $71-million Missouri-Kansas-Texas LPG pipeline, railroads have proposed rate cuts in a tactical move to undermine the project.

But shippers on the roads—Texas & Pacific, Rock Island, and Missouri Pacific—disagreed as to the effect of the proposed cuts between Southwest producing areas and Midwestern markets. Shippers also were not sure the new rates would go through.

The railroads announced their intention to cut rates 10 cents per 100 lb., or about half a cent a gallon. The reduction between Midland, Tex., and Minneapolis, an official said, would be from 88 to 78 cents per 100 lb.

The new rates are designed to hold business in the face of imminent construction of the Katy-backed Mid-America Pipeline Co. line. Mid-America hopes to have its West Texas-New Mexico to Minneapolis and Madison, Wis., line operating this fall.

Advantage threatened . . . The pipeline would take away considerable long-haul business from the railroads, which have steadily lost petroleum traffic with the rise of pipelining.

One potential pipeline shipper said the reduction, plus the increase of 1 cent per mile in the tankcar allowance to go into effect May 1, would largely wipe out the economic edge of the pipeline. The shipper viewed the railroad action as a threat to half the pipeline's initial volume, unless the pipeline lowers its own rates.

But a second shipper said: "I'll believe the cut when I see it."

Small-Tract Drilling Upheld

AN APPEALS court has ruled in Austin that a Texas landowner can drill for oil on his property even if it violates spacing rules set by the Texas Railroad Commission.

The court upheld a lower-court ruling that the commission erred in refusing to grant C. Murel Williams a Rule 37 exception to regular field spacing which would let him drill a well on a 1.65-acre tract in the Joaquin pool of Shelby County.

The commission based its refusal to issue a drilling permit on grounds that Williams owned a half interest in an adjoining 1.65-acre tract that had already been drilled. Williams contended he should be allowed to drill to avoid confiscation of his property.

watching WASHINGTON

Clyde La Motte

• Some tips on who will succeed Hussey . . .

THE MAN appointed to the Federal Power Commission to succeed the late John B. Hussey will be a Democrat, and most likely he will be from an oil and gas producing state.

It is also probable that the new commissioner will be a lawyer, probably with some experience as a state or city utility regulation official.

Furthermore, there is a fair chance that the new commissioner will be a Texan.

Such educated speculation by FPC observers is based on rules, custom, and the pattern of FPC appointments made by President Eisenhower.

The guess that the new appointee will be a Democrat is about as safe a prediction as one can make in Washington. The law specifies that not more than three of the five commissioners can be from the same political party. Since the FPC now has three Republican members, the new appointee obviously will not be from that party.

The President could appoint an independent. But there already is one independent on the commission (William R. Connole), so if the President were to appoint another it would leave the Democrats without representation. It is unlikely that the President would do that, or that a Democrat Senate, which must confirm FPC appointments, would approve.

Although there is no requirement concerning geographical distribution, or that producing states be represented, it is traditional to have the major sections of the nation represented and to have one member from a producing state.

The possibility that the new member may be a Texan stems solely from the fact that although Texas is the largest producer, the state has never had a member on the FPC. Louisiana and Oklahoma have been represented, but not Texas.

The prediction that the appointee will be a lawyer, particularly one with regulatory experience, is based on the pattern of such appointments made by Eisenhower. He has made a practice of appointing attorneys to federal regulatory agencies, and his FPC appointments have been men with some regulatory background.

• How Hussey's death affects the Phillips case . . .

THE DEATH of John Hussey may cause some delay in FPC action on the long-standing Phillips case, which the industry has hoped would set some sort of feasible pattern for regulation of independent producers.

The remaining four members may, of course, go ahead with a decision without waiting for a new member to acquaint himself with the case, or without even waiting for an appointment at all. However, because of the importance of the Phillips case and because there may be a two-two split on some issues, it is likely that the commission will hold up final action until a new member is seated.

It will be up to the new member to decide whether to participate in the Phillips decision. If he does, it obviously will take some time for him to acquaint himself with the problems involved, the hearing examiner's decision, and the reams of testimony that have been presented.

• Connole's reappointment seems certain now . . .

HUSSEY'S death may also have some bearing on whether Connole will be reappointed when his term expires in June.

There has been no indication by the administration, nor has Connole indicated whether he wants to be reappointed. But it seems logical now that the President, faced with choosing a replacement for Hussey, would hesitate about replacing Connole. To do so would mean putting two new men on the commission at almost the same time, thus further delaying already long-delayed FPC action on key regulatory issues.

Geophysicists Must Expand Talents, Cut Costs

• Smarter use of data and keener interpretative work by field parties are imperative, says SEG head T. O. Hall.

THE GEOPHYSICIST is facing his greatest challenge today: Cutting the geophysical cost per barrel of oil discovered by doing a better job of interpretation.

Beset by "forecasts of calamity" to his profession, the geophysicist, to survive, must be able to change a purely geophysical map into a map which is geologically sound.

He must be a competent field interpreter who is not completely dependent upon a geologist but still retains the full confidence of the geologist.

This straight-talking appraisal of the geophysicist and his problems came last week from the national president of the Society of Exploration Geophysicists, T. O. Hall of Houston. Hall also is president of General Geophysical Co.

Hall admitted at the outset of his address to the Geophysical Society of Houston that the dwindling geophysical business is still in the doldrums but added: "I refuse to join the prophets of doom." Part of the blame for losing ground, he said, must rest squarely on the geophysicist himself, but the drastic layoff of crews has tended to upgrade the industry generally.

"And through this upgrading, we are preparing the way for steps which must be taken to achieve the bright future which I am convinced lies in store for our industry," Hall said.

What can be done . . . Specifically, the oil industry "demands that we find oil—and at a lower geophysical cost per barrel than is indicated today."

This can be done in three ways: Reduce operating costs, develop effective new tools and techniques, and make better use of the data obtained by field parties.

Hall cited many methods by which the first two are being accomplished but said the third presents the geophysicist with his real challenge.

The failure to cut the geophysical cost per barrel of oil discovered is "a direct result of a failure to make maximum use of all available field data."

"Primary responsibility for interpreting geophysical data must lie at the field level—and this means that the party chief or interpreter on a field party is the man on whom much of this load will fall.

"All this resolves itself into demanding more and more of the interpretive personnel on field parties," Hall said. "We always have assumed that the party chief was capable of translating the wiggles on seismic records into vertical travel times and subsurface depths. We have assumed that the gravity interpreter was capable of transforming survey and meter notes into an intelligently contoured map.

"However, we all have been guilty in varying degrees of a failure to realize that the interpreter is responsible for translation of geophysical data into geological terms."

Field interpreters, Hall said, must be able to apply geological information to magnetic, gravimetric, and seismic data. But first they must be grounded in the fundamentals of geology. A man with a geological slant to his college education probably will be a better interpreter than one whose education was limited to physics and mathematics.

Future unlimited . . . After mastering the fundamentals of geology, the interpreter must follow up by learning the geology of the region to which he is assigned, studying electric logs, and checking drilling reports.

Hall said there are too few interpreters with "intellectual curiosity, rounded knowledge, and driving imagination." These qualities, he said, solved the problem of Julesburg basin seismic interpretation by using the top of the Pierre shale as a datum plane and led to successful wildcat tests.

It is management's responsibility, Hall said, to upgrade the requirements for field interpreters and then for the supervisors to put the policy into effect.

"The measure of our success in meeting this challenge will determine the future of our industry and, with it, the future of our chosen profession," Hall warned.

Brownsville Plant Revamped

UNION CARBIDE CORP. has begun revision of the synthetic-fuels plant at Brownsville, Tex., that it bought from Amoco Chemicals Corp. in December 1958 (OGJ. Dec. 8, 1958, p. 48).

Amoco shut down operations at this $100-million plant more than 2 years ago, describing it as "a technical success but an economic disappointment" (OGJ, Sept. 23, 1957, p. 84). This ended a 12-year effort by Amoco and nine other firms to produce gasoline and other fuels from natural gas and air.

These facilities will form the nucleus for Union's third petrochemical plant in Texas. Present plans are for manufacture of acetic acid, acetic anhydride, and methyl ethyl ketone.

The revision is expected to cost more than $2,500,000 and will be carried out by Brown & Root, Inc. of Houston. Completion is scheduled by early 1961.

PIPELINE BRIEFS . . .

A 27-mile 10-in. products line from Humble's Baytown, Tex., refinery to Houston is scheduled to be completed April 15 by Humble Pipe Line Co. W. L. Golightly Construction Corp. has the contract.

A 470-mile microwave communication network is being built for Columbia Gas System by the Texas Division of Collins Radio Co. The first part of the system will link Prestonburg, Ky., and Cedarville, W. Va., and later will extend into Pennsylvania and Ohio. It will serve United Fuel Gas Co., Manufacturers Light & Heat Co., and Ohio Fuel Gas Co., Columbia subsidiaries. The $1,500,000 system, expandable to 240 channels, will provide voice communication, teletype service, telemetering, supervisory control, and data communication.

Deliveries by Trans Mountain Oil Pipe Line Co. during the first quarter of 1960 are expected to be 124,000 bbl. daily compared with a 1959 daily average of 98,239 bbl. Favorable exchange arrangements made by some international oil companies boosted exports last year, the company reports. Exports to Washington refineries amount to 37% of total throughput last year compared with 30.3% in 1958.

Pamoil of Calgary has acquired assets of Edmonton Pipe Line Co. which operates 39 miles of main line

U. S. Storage Capacity Pinpointed by Survey

• A close look at how much petroleum storage space is available in this country is provided in detailed study. Total is 1,585,948,000 bbl.

IN THE MOST comprehensive survey of its type ever made, a National Petroleum Council committee found that petroleum storage capacity in the U. S. totaled 1,585,948,000 bbl. as of March 31, 1959.

This is 415 million barrels higher than any previous survey had shown, chiefly because this one included secondary storage as well as primary storage, and because it was extended to include jet fuel and all other products. Former surveys were limited to storage facilities for crude oil and the four major petroleum products.

The new survey, which includes storage capacity above 25,000 bbl. at any one location, was made at the request of the Department of Interior.

Because of its detailed coverage, the committee is confident that the capacity it reported constitutes at least 98% of all the oil-storage capacity falling within the definition outlined.

The committee pointed out that its survey covered capacity only and is not an indication of the amount of crude or products stored in these facilities. It also noted that crude-oil producers' lease storage was not included, nor was LPG or LRG underground storage.

Storage owned by the U. S. Government was not included, but private facilities leased to the government were included.

Furthermore, the committee's figures do not include capacity held by the ultimate consumer of the products, such as railroads, steamship lines, utilities, and manufacturers.

Interior Department requested the survey for defense planning purposes. The figures will be submitted to the Office of Civil and Defense Mobilization and will be used by the National Damage Assessment Committee, a group responsible for determining damage done by an atomic attack or some other national calamity.

The storage figures are broken down by states and counties, as well as by crude oil and product classification.

The industry chairman of the NPC committee was Robert L. Milligan, president of Pure Oil Co. The government co-chairman was Robert E. Roehl of the Office of Oil and Gas.

Storage Rundown

	(Barrels)
Crude Oil	452,710,000
Gasoline (Finished)	318,368,000
Gasoline (Unfinished)	98,161,000
Kerosine	55,844,000
Jet Fuel	29,169,000
Distillate Fuel Oil	248,946,000
Residual Fuel Oil	143,302,000
Other Products	239,448,000
Total	1,585,948,000

Hunt Loses Bid for 320-Acre Spacing

AN APPLICATION by Hunt Oil Co. of Dallas for 320-acre spacing west of Tioga field, Williams County, North Dakota, has been turned down a second time by the state industrial commission.

"Evidence does not conclusively establish that one well will drain 320 acres and that correlative rights will be protected," the commission said.

Hunt had asked the wide spacing in a field 11 miles long and 2 to 3 miles wide. It would have greatly expanded the present West Tioga field, covering 2¼ sections.

Company attorneys argued at the commission's February hearing that 320-acre spacing would be adequate to drain a thin layer of oil-bearing rock in the Madison formation. Closer spacing wouldn't justify further investment in the area, Hunt claimed.

Attorneys for objecting landowners contended there just wasn't enough information available to justify 320-acre spacing at present. The pattern remains at 160 acres.

and 43 miles of gathering lines. They extend from the Joarcam North and Joarcam South fields of Alberta to the Edmonton terminals of Interprovincial Pipe Line Co. and Trans Mountain Oil Pipe Line Co. The pipeline will be operated as a division of Pamoil and will handle crude from 435 producing wells.

Contract to lay 70 miles of 20-in. gas line from Abbotstown to the Fulton-Franklin County line in Pennsylvania has been awarded to Williams Brothers Co. by Manufacturers Light & Heat Co.

Western Natural Gas Co., Houston, has purchased a 240-mile crude-oil gathering system in West Central Texas from Sinclair Pipe Line Co. Lines extend from Coleman to Graford and also reach into Brown, Callahan, Eastland, and Stephens counties. Some crude from the 2-to-10-in. system will go to Western Natural's refinery at Fort Worth.

Contract for a 60-mile 6-in. products line from Daisetta, west of Beaumont, Tex., to the affiliated Beaumont refinery has been awarded by Magnolia Pipe Line Co. to Panama, Inc. Work got under way last week.

A 45-mile 3-in. products line will be laid by Phillips Petroleum Co. from the Phillips Mex-Tex line to American Oil Co.'s Artesia, N. M., plant. Contract has not been awarded. Phillips is laying 85 miles of 2 to 16-in. gas-gathering line under contract to Lasley Construction Co. Completion is due October 16, 1960.

Also for Pipeliners . . .

IN THE NEWS: NPC report shows lack of air space may stunt growth of radio in oil and gas industries (p. 108) . . . Railroads cut rates in move to undermine Katy's LPG pipeline (p. 109) . . . Interior's Bennett opposes end-use controls (p. 112) . . . Crude and gas systems to give Israel a boost (p. 114).

A complete list of pipeline projects begins on p. 207.

PLUS THIS TECHNICAL REPORT: Communications and control of a German crude line (p. 194).

Interior Opposes End-Use Controls on Fuels

• Bennett tells the NPC that the resolution to create a congressional committee to develop a fuels policy might lead to controls on competition between fuels.

LIKE MANY in the oil industry, the Department of Interior has grave doubts about the wisdom of establishing a joint congressional committee to develop a national fuels policy.

Elmer F. Bennett, Under Secretary of Interior, told the National Petroleum Council last week that the proposal "may be fraught with undesirable or even dangerous aspects."

He said flatly that it is the position of the Interior Department that, to the maximum practicable degree, freedom of economic choice should be maintained in the national interest.

"There has been a good deal of speculation in the press about the possible relation of such a proposal to the philosophy of end-use controls of certain fuels.

"We have in the past opposed such a philosophy and continue to believe that any action, which might lead to the imposition of controls in an effort to solve a problem generated by economic competition between fuels, should be very carefully excluded from our plans."

Defense plans . . . The council also heard Leo A. Hoegh, director of the Office of Civil and Defense Mobilization, suggest the possibility of appointing a small number of petroleum executive reservists as Interior Department "WOC's"—(without compensation)—to assist in all phases of peacetime mobilization planning and post-attack capabilities.

Hoegh said such a step would be at least a partial solution to the problem arising from the fact that executive reservists, as such, may not advise, consult, or act on any matters pending before any government agency.

The "WOC's," however, would be able to participate in such matters because they would be, in effect, government employes. Hoegh suggested the selection of at least one reservist from each state and OCDM region.

Other highlights of last week's NPC meeting included:

. . . **Adoption** of reports made by a committee on petroleum storage facilities (p. 111) and by a committee on petroleum industry use of the radio spectrum (p. 108).

. . . **Reelection** of Walter S. Hallanan as NPC chairman for the fifteenth successive time.

. . . **Rejection** of a proposal to discontinue transcripts of council meetings. The council felt that such transcripts are important so there can be no doubt about what is said or done in the council meetings.

Kewanee Sells Deep Rights

THE SALE of a portion of Kewanee Oil Co. deep rights in the Maljamar field of Lea County, N. M., has been made to Pan American Petroleum Corp. for a cash payment of $5,100,000.

The deep rights acquired by Pan Am are under 3,280 acres. The company's interest in production will be 60%, with Kewanee retaining a large overriding royalty interest.

Kewanee recently sold its shallow rights, including production, on this and other acreage in the Maljamar area to Continental Oil Co. for $10,000,000 in cash plus $25,000,000 in oil payments.

Interest in this area has been high due to a recent Abo discovery by Kewanee and Carper Drilling Co. on a unit which is adjacent to the acreage purchased by Pan Am. However, Kewanee's interest in the producing unit was not involved in the Pan Am deal.

PROCESSING BRIEFS . . .

An engineering and construction firm, Arthur G. McKee & Co., has formed a new operating subsidiary, A. G. McKee de Mexico, S.A., which will be headquartered in Mexico City. The company also is forming a similar firm in Brazil.

Esso Research & Engineering Co., has redesigned its fluid-coking process and developed a Model II fluid coking unit which is more compact and needs less plot area than its predecessor. Utility costs have been cut 35%, feed nozzles have been reduced 67%, and certain heat exchangers and pumps have been eliminated.

Allied Chemical Corp. is increasing methanol capacity by 50% and formaldehyde by 35% at its South Point, Ohio plant.

Repairs are under way at Lone Star Gas Co.'s Springtown, Tex., natural-gasoline plant that sustained an estimated $300,000 damage by fire February 25 following collapse of the ice-laden main cooling tower (OGJ, Mar. 7, 1960, p. 72). The plant, with a 250,000 M.c.f. daily capacity, will be back in normal operation by May 1, 1960. Partial operation is expected sooner than that.

A group of operators, headed by Mobil Oil of Canada, may construct a 30,000 M.c.f. gas-processing plant in the Wimborne area of Alberta. Necessary gathering, processing, and sulfur-recovery facilities would cost about $3,750,000. Daily production would consist of 100 bbls. of stabilized gasoline and 140 long tons of sulfur.

Texas-U. S. Chemical Co., jointly owned by Texaco Inc. and United States Rubber Co., will increase the SBR capacity of its Port Neches, Tex., plant by 10% to 156,000 long tons annually. Expansion will consist mostly of enlarging drying and carbon black masterbatch facilities with completion scheduled by late 1960. Engineering design work will be done jointly by TEXUS and Tellepsen Petro-Chem Constructors.

Also for Refiners . . .

IN THE NEWS: Journal's annual survey shows refiners are concentrating on adding downstream processing (p. 97) . . . Labor peace likely for oil due to OCAW and Teamsters defeats (p. 104) . . . Compact cars failed to live up to advance billing (p. 106) . . . NPC survey pinpoints U. S. storage capacity (p. 111) . . . BP's new West German refinery almost ready (p. 117).

PLUS THIS TECHNICAL FEATURE: A special 57-page report on refining in the U. S. and Canada (p. 120).

Where Rigs Are Running Abroad

	March 1960	Dec. 1959	April 1959
Latin America			
Argentina	101	99	73
Bahamas			1
Bolivia	9	9	12
Brazil	42	42	35
Brit. Honduras	1	1	1
Colombia	22	28	26
Chile	5	5	5
Cuba	1	1	2
Ecuador	5	5	4
Guatemala	3	3	1
Mexico	134	120	120
Paraguay			1
Peru	9	9	13
Trinidad	31	31	33
Venezuela	50	66	405
TOTAL	413	419	405
Western Europe			
Austria	19	19	19
Denmark			1
France	50	43	58
West Germany	130	130	130
Italy	36	36	36
Malta			1
Netherlands	4	3	3
Spain	8	8	8
United Kingdom	5	5	2
TOTAL	252	244	258
Africa			
Algeria	45	40	41
Angola	3	3	2
Brit. Som.		1	1
Egypt	5	5	5
Fr. Eq. Africa	9	9	11
Fr. West Africa	5	2	2
Libya	31	24	8
Madagascar	2	2	1
Morocco	1	3	4
Nigeria	8	8	7
Somalia	2	2	2
Tanganyika	1	1	
Tunisia		1	1
TOTAL	112	101	85
Middle East			
Iran	13	10	10
Iraq	14	6	8
Israel	4	4	4
Jordan	1	1	1
Kuwait	3	3	7
N. Z.	5	5	4
Qatar	2	1	1
Saudi Arabia	3	4	3
Southern Arabia	3	3	3
Syria	2	2	2
Turkey	8	8	5
TOTAL	58	47	48
Asia-Pacific			
Australia	5	3	4
British Borneo	2	2	2
Burma	4	4	3
Formosa	1	1	1
India	6	5	5
Indonesia	15	15	15
New Guinea (Inc. Papua)	1	2	1
New Zealand	1	1	1
Pakistan	5	5	6
Philippines	3	2	1
Timor	1	1	
TOTAL	44	41	39
GRAND TOTAL	**879**	**852**	**835**

NOTE: Estimates are made where complete up-to-date reports are lacking.

Foreign Drilling Hits All-Time High

• More rotaries are working now than in late 1959. The additional number is mostly scattered through Africa and the Persian Gulf. Fewer operations in Venezuela continue to hurt contractors, but they are busier in Argentina.

THERE are more rotary rigs cutting rock today in the free world outside the U. S. and Canada than at any time in the history of the oil industry.

The 879 rigs now making hole on both exploration and development locations is easily a record. The figure tops the previous high of late 1959 by more than 25 rigs.

In contrast to the increased foreign activity, U. S. drilling is still dropping. There were 1,651 rigs operating in the U. S. at mid-March, 516 fewer than early December. Canadian operators look better. They are operating 235 rigs, an increase of 36 over the December tally.

Africa . . . More rigs are moving into Libya, where a growing number are being assigned to development work on recent discoveries.

Of the 31 rigs in the country, Oasis Oil, operator for Ohio Oil, Continental Oil, and Amerada, has the most with 12. Esso has five; Royal Dutch-Shell and Amoseas, three each: Gulf Oil, Mobil Oil, British Petroleum, and a French company, CPTL, each have two.

To the west in Algeria, 45 rigs are making hole in the French Sahara. SN Repal and CFP(A), each of which is developing half of Hassi Messaoud oil field, have 12 rigs running.

CREPS, 35% owned by Royal Dutch-Shell, is the most active driller in the Sahara with 15 rigs. Two of the rigs are drilling development wells at Edjele, and four are on development work at Zarzaitine. The combined reserves of the two fields are now estimated at 110 million tons, or more than 800 million barrels. A 24-in. pipeline outlet to the Mediterranean Coast will open this year.

Cities Service and its French partners, PREPA and FRANCAREP, are nearing 10,000 ft. in a test at Bou Aicha. Cities Service has 49% interest in the venture.

Interest continues high in the coastal basins of West Africa, where crude output from Nigeria, Gabon, and Angola has risen above 35,000 bbl. daily. No American companies as yet have production in this area. But two are drilling in joint ventures with French companies. Mobil Oil,

in partnership with SPAEF over part of SPAEF's Gabon concession, has two rigs drilling at the Rembo Kotto discovery.

Plymouth Oil has half interest in a wildcat at Berou on the Ivory Coast of French West Africa. The test is nearing 11,000 ft. SAP is the French partner.

On the East Coast of Africa, Sinclair Somal, owned by Sinclair Oil and Conorada, has started a new wildcat in Somalia. An ENI affiliate, AGIP, continues to operate a rig in the northern part of the country.

Persian Gulf play . . . There are now half dozen offshore drilling operations in the Persian Gulf.

The Japanese-owned Arabian Oil Co. is in the limelight because of its flush discovery off the Neutral Zone. The company plans to drill eight or nine more wells this year and a total of 43 by 1964. International Drilling Co., the drilling contractor, has started the first stepout.

Pan American International (Indiana Standard) is drilling ahead at 11,633 ft. in marl and limestone in its first test on an offshore concession from Iran. Shows have been encountered below 11,500. Pan Am plans to start a second offshore well in April.

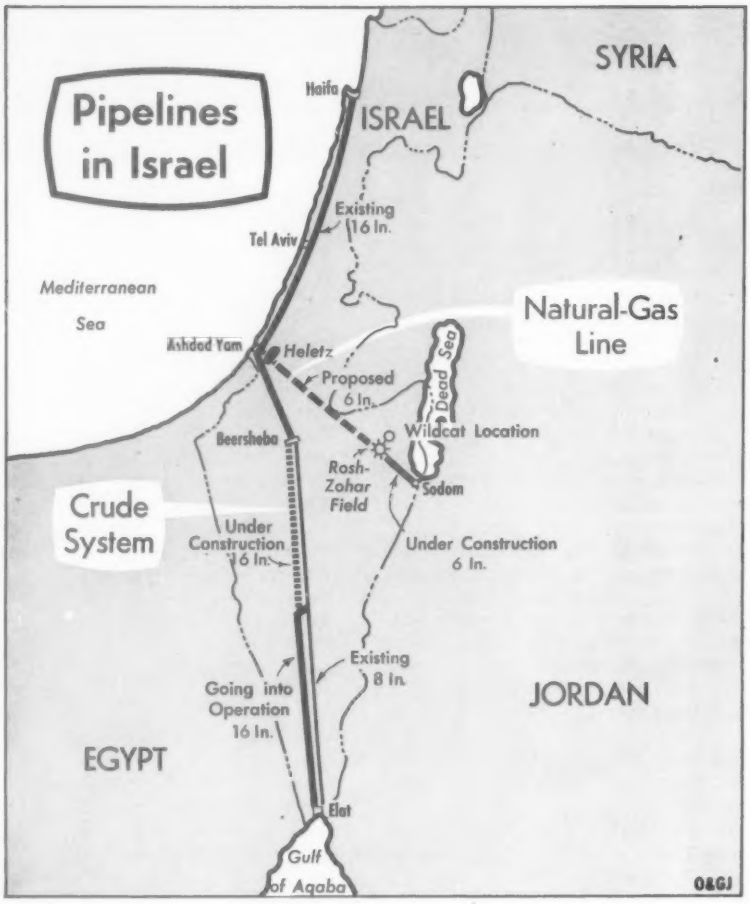
An affiliate of the Italian Government company, ENI, has reached 7,462 ft. in its concession off Iran. Elsewhere in the Gulf, Aramco is drilling at well at Manifa, Royal Dutch is drilling a wildcat off Qatar, and British Petroleum and CFP are drilling at their Umm Shaif discovery off Abu Dhabi.

Venezuela drags . . . Drilling contractors have been hard hit by the slowdown of operations in Venezuela. Of the 50 rigs on wildcat or development wells, only 14 are contract rigs. A year ago, contractors were running 33 rigs on this type of work.

Loffland Brothers is the most active contractor with four rigs. Santa Fe Drilling and Delta Drilling each have three. Kerr - McGee has two. Helmerich & Payne and Zapata each have one. Contractors have another seven rigs on workover and service, compared with 15 a year ago.

Elsewhere in Latin America, drilling is on the rise. Three-hundred wells are planned for Trinidad this year, Six rigs are making hole on the Trinidad side of the Gulf of Paria.

Some of the Venezuelan slump has been made up by contractors in Argentina, where there are 101 rigs making hole. Mexican drilling also is at a high level. Of the 134 rotaries active, 96 are operated by Pemex and 38 by private contractors.



Pipeliners Busy in Israel

• Both crude and gas will be moved to the Mediterranean when current pipeline building programs are completed.

ISRAEL has no cure in sight for its oil shortage. But a fast-moving pipeline construction program and a newfound gas field soon will offer more relief from the headache.

The syndicate building a 125-mile 16-in. crude line from Elat to Beersheba has opened the first 60 miles without waiting for the entire section to be completed in June. The completed link has been tied into an existing 8-in. line that will be closed down when the new 16-in. line is finished.

The $24-million project will make the 257-mile system from Elat to Haifa refinery 16-in. over its entire length. By July 1, the temporary pumping station at Elat is expected to be able to push through 34,000 bbl. daily of crude from the Persian Gulf.

A permanent pumping station under construction at Elat will boost capacity to 58,000 bbl. daily next year. Two more pumping stations will be built later, if needed, to increase capacity to 116,000 bbl. daily and 150,000 bbl. daily with each addition.

Baron Edmond de Rothschild heads the group operating the system.

Zohar gas field . . . While imports are the mainstay of Israel's oil supplies, the country now expects to trim some of its foreign oil bill by developing a gas find at Rash-Zohar, west of the Dead Sea.

Rosh-Zohar is the country's first gas field and the first commercial find since the discovery of Heletz oil field 5 years ago. Heletz, and the related Brur structure, produce about 2,000 bbl. daily.

Naphtha Israel Oil Co. estimates its gas reserves at 45 billion cubic feet on the basis of four wells. The No. 6 well has encountered the gas zone, but is being carried deeper to test oil shows found at 5,570 ft. The oil formation

in the discovery, however, was too tight for production.

The company has brought a second rig into the field and is rigging up for No. 5, which will seek the water table on the southern edge of the field.

An 18-mile 6-in. pipeline to a potash plant at the biblical city of Sodom will open in 3 months, delivering the equivalent of about 500 bbl. daily of fuel oil.

Another proposal has been made for a 75-mile gas pipeline to supply a new power station at Ashdod Yam, on the Mediterranean. This project may hinge on the outcome of tests on the No. 5 and 6 wells. If they are as prolific as No. 4, which tests 7,150,000 cu. ft. daily, reserve estimates of the field will be doubled.

The field's potential is now rated at the equivalent of about 1,700 bbl. daily of fuel oil.

Naphtha Israel has made a joint exploration agreement on three licenses to the southwest held by Universal Petroleum Co. The move was made to give Naphtha a chance to test a series of structures similar to Rosh-Zohar extending southwestward from the Dead Sea.

Haifa Products Sold

. . . to Turkey, pointing to new competition in area.

MARKETERS in the Mediterranean area are finding competition from Israel's Haifa refinery a factor to contend with.

The Turkish Public Works Department has awarded a contract for 60,000 tons of asphalt to Haifa Refineries, which underbid its foreign competitors. Bulk deliveries in a special tanker are starting immediately.

The asphalt is moving out through the old Iraq Petroleum Co. loading terminal which has been turned over to the refinery by the government.

Only one of three distillation units at the 87,000-bbl. plant has been in operation since the Israel-Arab war in 1948. But an inspection of facilities has shown that one of the two other pipe stills still is in working order. The third unit will be rebuilt.

The refinery management also plans to start selling products to local marketers on a posted-price basis. At present, marketers import crude and have it refined at a cost-plus basis.

It was not learned immediately whether the asphalt export sale was made directly by Haifa Refineries, or through United Petroleum Export Co., a partly owned subsidiary set up especially to handle export sales (OGJ, Feb. 8, p. 77).

TGT Expands Abroad

• Most of company's foreign work is centered in South America, but it has just won a concession in Nigeria.

TENNESSEE Gas Transmission Co. is spreading its wings again.

Last week Gardiner Symonds, board chairman and president, announced that a new division, Tennessee Overseas Co., has been organized to direct Tennessee Gas' exploration and production work outside North America—and also disclosed that Tennessee Gas is preparing to invade Nigeria. Only recently the company obtained an interest in a Spanish Sahara concession.

Symonds described the Tennessee Gas philosophy in going abroad. Foreign countries, he said, are anxious to provide their own supplies of fuel and energy and are willing to make deals with U. S. companies advantageous to both the countries and the companies.

Symonds has just returned from a 15,000-mile, 19-day tour of South America. The company's largest overseas investment is in South America, notably Argentina.

The new Tennessee Overseas Co. will be headed by R. C. Graham, who is also president of a sister division, Tennessee Gas & Oil Co., which is responsible for domestic and Canadian exploration and production. S. C. Oliphant will be executive officer of Tennessee Overseas and Wilton E. Scott of Tennessee Gas & Oil.

Africa . . . Tennessee Gas has formed Tennessee Nigeria, Inc., to receive an exploration license from the Nigerian Government on 1,200,000 acres on the coast of the Gulf of Guinea. The concession is east of Lagos, the capital.

Adjoining concessions already have production.

In the Spanish Sahara, Tennessee Gas owns a 5% interest in 1,300,000 acres. The concession is held by the Valdebro group, and the operator is INI, the Spanish Government oil agency.

Argentina . . . Tennessee Argentina, S. A., a subsidiary for Argentine operations, has concentrated on the island of Tierra del Fuego at the southern end of Argentina and has had considerable success.

The company last year contracted to explore 3,435,000 acres on the island for YPF, the government oil agency.

Production already had been established, but the company extended La Sara field both north and south with wildcat extension wells. The drilling has resulted in seven oil producers. There are 50 proved locations to drill.

Tennessee Argentina found more than 200 ft. of net oil sand at about 7,000 ft. in its La Sara South No. 1. It was completed at 1,480 bbl. daily, and the company expects the field to be a big one. Drilling so far has indicated no limit of production for La Sara field.

Another Tierra del Fuego wildcat well—a rank one 30 miles from production—also has been drilled and is awaiting completion tests from 50 ft. of sand.

The company has plenty of other work to do in addition to its wildcat program. Prior to Tennessee's entry into the picture, wells had been drilled indicating discovery of seven other fields. These are now being developed and evaluated.

To move the oil now being produced on the island, Tennessee is building a submarine pipeline into San Sebastian Bay, where tankers can move the crude to YPF. Brown & Root Marine Operators, Inc., holds the contract for the pipeline and will complete the job by June (see PHOTOS in the News, p. 119).

Other South American . . . Tennessee Gas is operating in Venezuela, Ecuador, and Bolivia as well as Argentina.

Tennessee Venezuela, S. A., holds a 15% interest in 1,960 acres in Lake Maracaibo, and the company's net production was 5,100 bbl. of oil daily at the close of 1959. Fifteen producing wells have been completed since TGT acquired its interest in 1956.

Tennessee del Ecuador, S. A., holds full interest in some 3 million acres of land and 198 producing oil wells in Ecuador, acquired in 1958. It also owns a small refinery of 2,000-bbl. capacity. The company has two drilling rigs testing prospects on the concession.

Chaco Petroleum, S. A., a Bolivian subsidiary, is the operator and 35% owner of a 666,000-acre lease obtained from the Bolivian Government in 1957.

The company abandoned a 14,955-ft. wildcat earlier this year but now has a 14,000-ft. test drilling below 6,000 ft. on the Palo Marcado structure.

Japs to Get into Liquid-Methane Picture

• Big rubber company has no immediate plans for liquid-methane shipments, but it is building a tanker which can handle the product. Initially, the tanker will be used to haul LPG from Kuwait.

JAPAN'S leading rubber manufacturing company has inserted its big toe into the doorway of the country's prospective future market for imported natural gas.

Bridge Stone Tire Co. has announced publicly its plans to import 135,000 tons of propane a year from Kuwait from supplies furnished by British Petroleum Co. The LPG will be moved in a new 15,000-ton refrigerated tanker which the rubber company plans to build.

In all the flurry of announcements in connection with the new LPG import contract, one fact was obscured. The $8,250,000 tanker is being designed to move liquefied methane.

With a firm deal already made with British Petroleum, the Japanese rubber company now needs Japanese government approval for the project. The BP contract was the first step in getting the approval. Next, Bridge Stone plans to make a deal with Mitsubishi Nippon Heavy Industries to build the tanker based on the principles used by Conch International Methane in the Methane Pioneer. The Pioneer has just completed a series of seven trial voyages between Lake Charles, La., and Canvey Island in the Thames River hauling liquefied natural gas to the British Gas Council.

The prime mover behind the Bridge Stone Tire plans is Yasuhiro Go, the only Japanese among those who traveled on the Methane Pioneer on her maiden voyage in February 1959.

The Japanese rubber company thinks the first tanker of its type ever built in Japan—and only the second in the world—will cost about $550 a ton compared to Japanese shipbuilding costs of about $200 a ton for conventional tankers. The company plans to establish a new and separate affiliated firm to handle the LPG imports, and apparently later liquefied methane. The total investment planned will be about $14 million at the outset.

Receiving facilities for the refrigerated LPG will be installed at Kawasaki, between Yokahama and Tokyo. Present plans are to limit end use of the LPG for domestic heating to only 30% of the planned imports to avoid open competition with Japan's declining coal industry. The remaining 70% of the imported supply is to be earmarked for chemical and industrial uses.

Bridge Stone Tire hopes to have the refrigerated tanker in operation soon enough to make its first delivery of Kuwait LPG by mid-1961.

LPG demand in Japan . . . Bridge Stone Tire is by no means the first Japanese company to flirt with the idea of a large-scale LPG business in a country particularly suited to be served on the domestic front by LPG.

Tokyo Gas Co., one of the country's big three city gas manufacturers, recently established a subsidiary, Tokyo LP Gas Co., to sell bottled gas no later than April to domestic consumers beyond the reach of present gas distribution systems.

Tokyo LP Gas thinks it can develop a new market for LPG of at least 2,700 tons the first year of operation with a selling price of about $280 a ton delivered.

In another development, Japan's first LPG tanker, the 1,000-ton "LP Maru No. 1," was completed in January to move butadiene through Japanese coastal waters supplying the chemical industry. The vessel, of the standard pressurized type, was built by Harima Shipbuilding Co. for Japan Liquefied Gas Transportation Co.

It will move butadiene from Sumitomo Chemical's Niihama plant and Mitsui Petrochemical's Iwakuni plant to Japan Synthetic Rubber Co.'s Yokkaichi plant beginning in April.

Bridge Stone Rubber curiously enough has an interest in Japan Synthetic Rubber.

India Kills Deal to Import Red Oil

THE INDIAN Government has turned thumbs down on a deal between a private Indian company and the Soviet Foreign Trade Agency for the purchase of Russian crude.

K. D. Malaviya, minister for oil, personally called on the Russian ambassador to India after learning of an import agreement made by Hindustan Organizers Private, Ltd. The outcome was an understanding that any imports of oil will be made on a government-to-government basis.

Small amounts of oil from Russia, however, will be imported for the first time under terms of the 1960 trade agreement. Malaviya gave no figures, but said the imports are far below what he hopes for later.

At least six groups are discussing exploration rights with India under the terms of the government's revised oil law (OGJ, Mar. 14, p. 118).

The list of interested companies includes Royal Dutch - Shell, Stanvac, Caltex, Gulf Oil, ENI, Continental Oil, and Kerr-McGee. French, Japanese, and German firms also are showing an interest.

The major attraction is that India will have a waiting market for local crude production developed.

Gas Well in Southwest France Tested

A NATURAL-GAS discovery in southwestern France tests 14 million cubic feet daily.

RAP says its Charles 1 well is capable of making 10.5 million cubic feet daily on regular production. The well flowed 14 million cubic feet daily on test with a wellhead pressure of 996 psi.

The Charles well appears to be as good as those in the 22-year old nearby St. Marcet gas field. The new well is about 2 miles northwest of the northernmost St. Marcet well. It encountered a gas-bearing limestone formation between 7,040-7,075 ft.

In the Paris basin, two more discoveries have been made in the Chateaurenard area, 65 miles southeast of the French capital.

FROPEX recovered 3 bbl. of crude on a 45-minute test from 1,925 ft. in a wildcat at St. Firmin des Bois, 2½ miles southwest of Chateaurenard, which produces 400 bbl. daily.

The second FROPEX find has been made at Sens, 25 miles northeast of its production. The well tests 11 bbl. per hour from 3,470 ft.

BP's New German Refinery Almost Ready

WEST GERMANY'S refining capacity will increase 100,000 bbl. daily in one step at mid-year with the opening of British Petroleum's new plant at Dinslaken.

Facilities at the plant include a 17,500-bbl. vacuum unit, a 10,000-bbl. FCC unit, a 10,000-bbl. Platformer, and a 3,000-bbl. asphalt plant.

Crude stocks will be drawn from the year-old 230-mile pipeline from Wilhelmshaven to the Ruhr. Products will be distributed by road, rail, and by barge on the Rhine River.

The new capacity will come on stream at a time when the local oil industry is learning to live with a new tax specifically designed to limit the growth of fuel-oil sales.

The West German Bundestag has approved special taxes on medium and heavy fuel oils and on light oil used for house heating. The levy on medium and heavy oils is $7.20 per ton, or more than $1 per barrel. Fuel oil used for domestic heating will be taxed about $2.40 per ton, or about 33 cents per barrel.

The tax will go into effect April 1 and continue until March 31, 1963. In case of emergency, the government can raise the tax on industrial oils to as high as $10.80 per ton, and on domestic heating oil to $7.20 per ton.

INSPECTORS check a weld on top of a storage tank at BP's new refinery in West Germany. The 100,000-bbl. plant will go on stream this summer.

The tax has been a hot political issue for months. It must pass through the Upper House before it becomes law. But no further delay is expected. The revenue will be used for relief of coal miners hit by the closing of some of the country's mines.

FOREIGN BRIEFS . . .

British Petroleum and Petrofina plan to double capacity of their jointly-owned 90,000-bbl. refinery near Antwerp, Belgium. The Soc. Industrielle Belge des Petroles plant will be expanded to 180,000 bbl. daily by 1962.

Russian exports of crude and refined products last year rose 40% to 500,000 bbl. daily. Well over half of the oil was sold or bartered in free-world markets.

Pemex will build a $1-million products terminal at Tijuana, Lower California. It will handle products from Minatitlan refinery coming via a pipeline across the Isthmus of Tehuantepec, and then by tanker from Salina Cruz. The area has been supplied by imports from the U. S. West Coast.

South Korea has approved a 15,000-bbl. refinery to be built jointly by local interests and an unnamed American company. Korean Petroleum, a company set up by local marketers and shippers, will supply $5 million in foreign exchange for the plant. The American partner will put up $8 million. Another $2.5 million in local currency will be required. The refinery will be the country's first. Possible locations are Masan, Mokpop, Yosu, or Ulsen. The plant is expected to go on stream in 4 years.

C.S.R.C.-Dow, Pty., Ltd., jointly owned by Dow and C.S.R. Chemicals, Pty., Ltd., Sidney, will invest $3,375,000 at their styrene plant at Altona, Australia, for facilities to produce ethylene dichloride, caustic soda, and chlorine.

Royal Dutch-Shell will send a team of geologists to Spitsbergen this year to conduct a preliminary survey. Spitsbergen is 375 miles north of Norway.

British Petroleum is buying half interest in Petko A/B, Finland's leading fuel-oil supplier. The company handles 34% of the local fuel-oil market, or more than 4,000 bbl. daily, and 17% of diesel-oil sales, or more than 800 bbl. daily.

Collapsible, sausage-shaped barges will be put on the market commercially by a new British company, Dracone Operations, Ltd. Several of the flexible, seagoing containers already are in service as products carriers in Britain, Nigeria, and the Far East. The barges are towed behind boats, or small tankers, and carry from 100 to 2,500 bbl. of products.

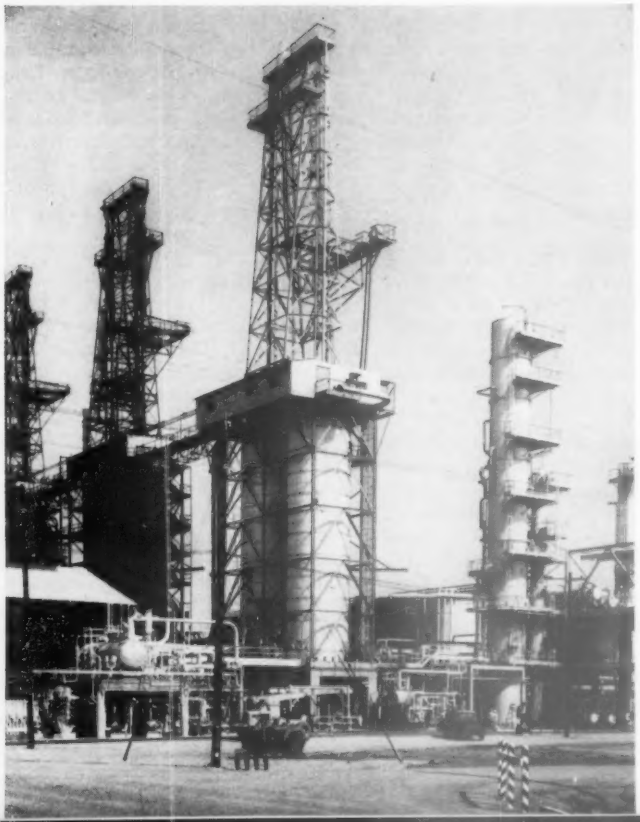
East Germany has ordered a 40,000-ton per year ethylene plant from two British firms, Petrocarbon Developments, Ltd., and Humphreys & Glasgow, Ltd. The unit will be the first complete chemical plant to be supplied to East Germany from the United Kingdom, and the first of its type installed by British companies anywhere abroad.

A 350-ton per day dewaxing unit is being installed at the 5,600-bbl. Neuhof refinery, near Hamburg, Germany, of Oelwerke Julious Schindler, G.m.b.H., in which British Petroleum has an interest. The $4,760,000 unit will go on stream next year.

PHOTOS IN THE **NEWS**

Sounding for oil

GEYSERS like this will be commonplace in the Mississippi Sound as Shell starts an ambitious seismic exploration program. The geyser is created by a small "suspended" detonation of ammonium nitrate floated in water about 4 ft. below the surface. On occasion a buried detonation is used. In that case, crew drills holes below the sea floor and detonate the explosive there. Shell's seismic work may continue for 2 years on 800,000 acres in the sound Shell has leased from the state of Mississippi.

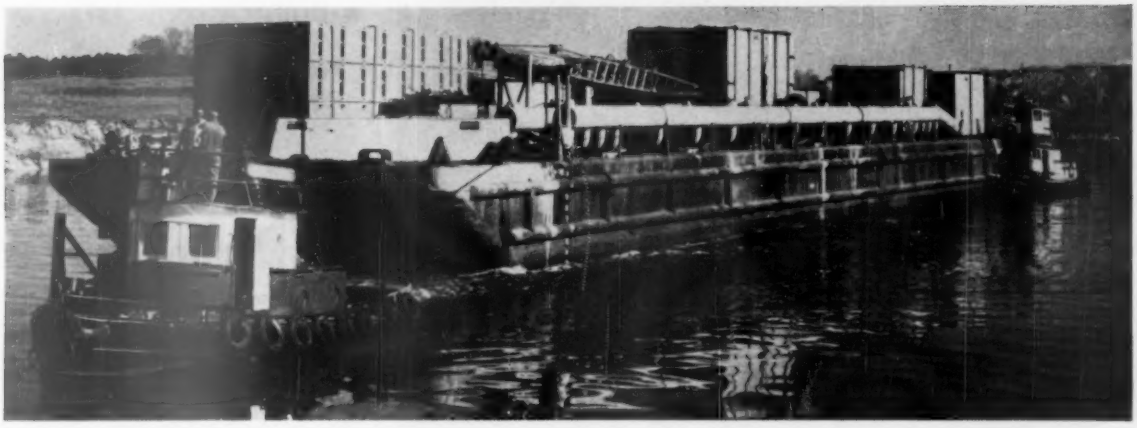


A dwindling breed

LARGEST delayed coking unit in the world is the title claimed for Mobil Oil's new facility going on stream at the Torrance, Calif., refinery. The 9,300-bbl.-daily unit increases Torrance coking capacity to 35,000 bbl. daily. The increased emphasis on coking on the West Coast is contrary to a national trend. Mobil's facilities, however, are the answer to a peculiar marketing situation on the coast created by antismog laws and the invasion of natural gas.

Slick way to handle grease

A NEW METHOD of delivering liquid grease looks like a money and time saver. Cities Service has inaugurated the service in the Chicago area. The company has quit delivering grease in 400-lb. drums and switched to deliveries from a new truck which is equipped with two tanks with a capacity of 12,000 lb. each. Two of the big problems in the past have been the storage space required for the drums and the manpower needed to handle the drums. With the truck deliveries, the grease is moved directly from the truck into a customer's central storage area. It takes only about an hour to empty the two tanks on the truck.



Argentina bound

THE M-211 pipelaying barge of Brown & Root Marine Operators left the Houston ship channel last week for a 2-month tug haul to Tierra del Fuego at the southern tip of South America. It will be used to lay two 3-mile pipelines from the island to San Sebastian Bay. The line will move newly developed crude reserves resulting from a drilling program being carried out by Tennessee Argentina, S. A. (see related story, p. 117).

Jet power for gas line

A MODEL of what will be the first compressor station powered by a jet aircraft engine is checked out by the three men most responsible for coming up with this new pipeline technique. The J-57 engine will be built into a 10,500-hp. experimental station which will be put into operation by Columbia Gulf Transmission at Clementsville, Ky., this summer. The three Columbia Gulf men checking out the model are, left to right, C. W. Morrow, assistant chief engineer; F. B. Sessions, chief engineer; and M. M. Levy, Jr., project engineer. Cooper-Bessemer and Pratt & Whitney jointly developed the compressor unit. The engine has been modified to burn natural gas. The engine exhaust will drive the power turbine, which in turn will drive a two-stage compressor.

Special Refining Section

C. DUDLEY JOHNSTON

IN THIS SECTION

1. Refiners Foresee No Major Breakthrough
2. What's Ahead for the Sixties
3. Report on Isocracking
4. Report of Gulf's HDS Process
5. Computer Control of Cat Reforming
6. Journal Refinery Survey
7. Report on New Refinery Construction

Refiners foresee . . .

- Cheaper units
- Cheaper operation
- Cheaper maintenance
- Better products distribution

But . . .

No major

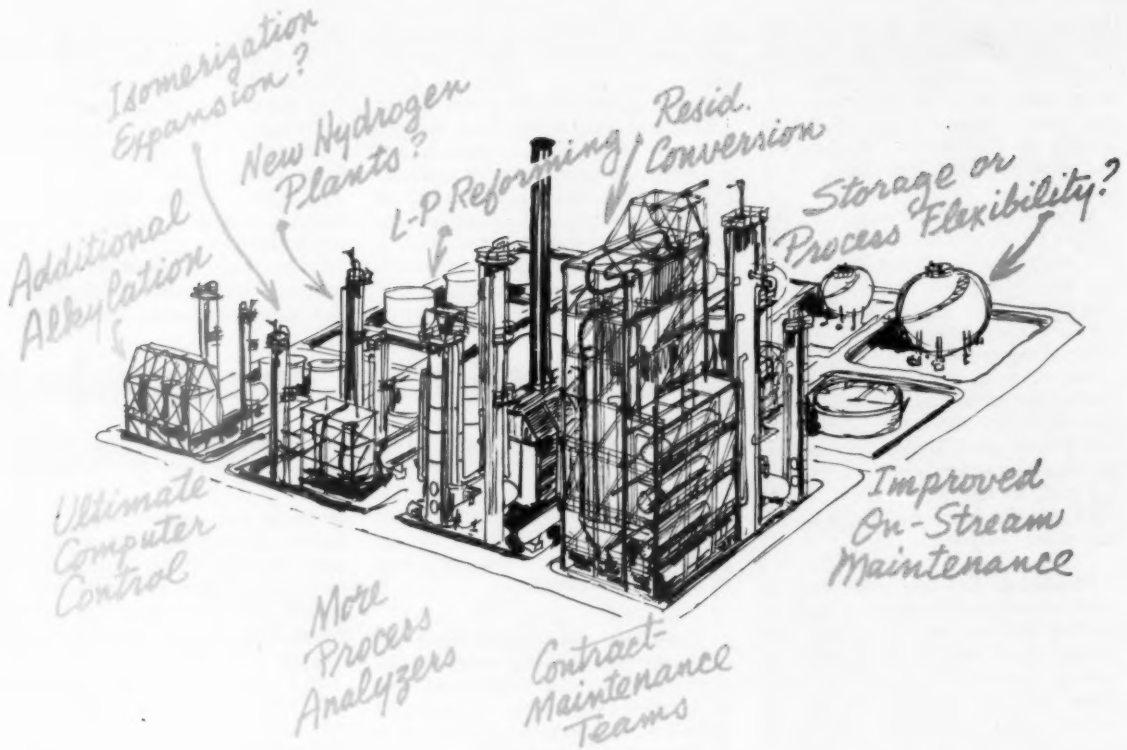
THERE'S no big breakthrough in sight for refining. This represents the almost unanimous opinion of experts in research, processing, instrumentation, and maintenance. Several representatives from each of these refining fields have been interviewed recently by The Oil and Gas Journal. They overwhelmingly expressed the opinion that over the next few years changes will consist of relatively small improvements in existing processes and techniques.

There are no startling new processes on the horizon. Neither is there particular need for any.

Outlook for Processing

While industry projections for compression ratios and fuel requirements vary somewhat, the composite thinking seems to be that compression ratios will reach about 12:1 by 1966 or 1967. Premium gasoline is expected to run about 103 or 104 research octane, and regular should reach 97 or 98 by that time.

The feeling is that this octane increase will largely be met by better operation and more severe operation of existing units. Where possible economically, alkylation is expected to get the nod. Refinery isobutane pro-



refining-process breakthrough

duction will be maximized, and the C_4, C_3, and C_5 olefins will be used, in that order, to make alkylate for the gasoline pool.

It is expected that motor ratings of premium pool gasoline will more closely approach the research ratings. This, too, means more alkylation. And alkylation will give a good middle fill to blends of light and heavy components now being used.

Also pointing up the importance of alkylation is the recent midwestern trend to rate gasoline octane by adding research and motor ratings together, without differentiating as to which part of the final number comes from research or motor ratings.

No isom agreement. There is no agreement among the experts as to what part isomerization of C_5 and C_6 will play in the increased emphasis on motor ratings and in the effort to reach the higher octanes expected in the next few years.

Comments ranged from, "Pentane and hexane isomerization is the last resort in getting octanes," to "Isomerization should definitely be the next process to get anything like widespread adoption."

Most opinions lay somewhere in between these extremes. Some spokesmen liked the theory of the process but said none of the existing commercial adaptations were satisfactory. Better processes are being developed and will be available if and when needed, they said.

One expert stressed the increasing importance of jet fuels. The refiner may find that it will be necessary to separate branched-chain from straight-chain compounds, to meet quality requirements for both fuels. In this instance, isomerization could became very important, he said.

Several men pointed to low-pressure reforming as an alternate means for upgrading light naphtha. Low-pressure operation promotes isomerization and aromatization of the light components. The reformer could run on blocked-out operation, at low pressure for light naphtha, and at the usual conditions for the heavy naphtha.

Also needed for the higher-octane operations of the future: better processes for removal of low-octane paraffins from the gasoline pool, the experts agreed.

Residual conversion. The ratio of gasoline to other products from the crude barrel is expected to rise. This trend prompts a look at processing of residuals and middle distillates to gasoline.

The men agreed that residual conversion is necessary, but they chose different routes. Most thought that residual cat cracking might prove the most promising. At least two processes are available, utilizing for the most part regular cracking catalysts and about the same conditions as regular cat cracking.

Some spokesmen were partial to coking of the residual. This route looks particularly attractive for sweet crudes or crudes with low metals.

Caution was expressed in remarks such as, "The breakeven point on cat cracking is somewhere in the heavy vacuum gas-oil range. It is not economical to go to residual cracking," or "There's no need for the process where there is a market for fuel oils and middle distillates."

There was general agreement that hydrocracking of residuals cannot be justified at this time.

Middle-distillate conversion. The experts think that hydrocracking of middle distillates will be reserved for special situations where heavy crudes are being processed and demand for fuel

oils and residuals is practically nil. The universal comment was that hydrogen is at a premium, and is already being used 100% in most refineries. And there is need for more hydrogen to treat cat feed stocks, cat cycle oil, and middle-distillate products, and to finish lubes.

Some of the men foresee that hydrogen plants will have to be installed in many refineries, due to other needs, and that hydrocracking will then appear much more attractive.

One spokesman pointed out that hydrocracking processes are available at a time when cat crackers generally are overloaded with cracked light products which for the most part end up as overhead gases. Hydrocracking middle distillates will relieve the cat cracking load, leaving the crackers free to work on the heavier oils for which they were designed.

Flexibility. Refiners still feel the need for process flexibility in the production of gasoline or middle distillates. Most interviewers felt that the most profitable way to get this flexibility would be to build it into the catalyst. And work along this line is going on.

One man suggested polymerization as the mechanism for converting gasoline and lighter materials to middle distillates.

Still another reported that it is now much cheaper to provide storage than to try to build in processing flexibility on middle distillate-gasoline production.

More Economical Operations

Economical refinery operation begins with unit design, and much work is being done to design more precisely, without costly excess capacity. One respondent stressed that the refiner should strive for optimum investment, not minimum investment. Usually minimum investment means excessive maintenance costs. Where possible, quantity-quality flexibility should be built in. When demand lags, it may be possible to offset this by lowering throughput and upping quality.

The trend is for more effective integration of process units into fewer operating and control points. This also means larger units, built closer together for easier accessibility and maintenance. However, the trend can be overdone.

The need is to cut cost, while at the same time maintaining flexibility. One expert pointed out that he would build two 75,000-bbl. crude units, rather than one 150,000-bbl. unit. One big operating upset may pay for the difference, he said. This same man uses a factor of 1.5 in building a cat cracker, and he doubles up on some auxiliaries to insure good onstream time.

Much money can be saved by the elimination of intermediate tankage between units. This is good if not overdone. Provision must be made for plant startup, and all units can't be started simultaneously. Adequate bypass provisions should be provided.

Money can be saved by taking a close look at the need for corrosion-resistant materials. It's generally a good plan to start with the minimum and add as needed. Judgment and experience can show where they may safely be eliminated.

Increasing runs. Longer runs between shutdowns mean much savings to the refiner. Process-unit runs of 4 to 5 years are possible and in some cases desirable. Esso Standard division of Humble Oil & Refining Co. recently completed a 4-year run on the Baton Rouge, La., cat cracker.

The company has developed an onstream maintenance inspection technique utilizing five nondestructive testing techniques: (1) nucleonics, (2) gamma-radiography, (3) ultrasonics, (4) thermometrics, and (5) electronics. These tools are used as needed to determine condition of equipment while it is on stream. Small sections of the unit can then be isolated for repairs.

One man urged caution in extending runs indefinitely. It's much better, he said, to be able to shut down when you want to, rather than have a long emergency shutdown at a most inopportune time. A shutdown should be planned so that least interruption of products flow occurs, and so that there is minimum inventory of charge stock when down time starts.

And turnarounds should not be longer than 10 days to 2 weeks, he said. It's better to limit run duration to make sure that control over these factors is maintained. Still, his company is leaning toward longer runs of 18 months to 2 years because of better maintenance techniques.

Planning for the next turnaround should start before the unit is back on stream from the last one. During down time, the unit should be inspected thoroughly to see what will be needed next time. It should be ready and as completely assembled as possible when the unit is next taken off stream. And the planning should proceed steadily and continually during the run.

Other suggestions for cutting maintenance expense:

- Make full use of additives for corrosion prevention. Additives are continually being improved and made more widely applicable.
- When a company has several refineries, critical parts and equipment can be bought and stored in a central location, ready for shipment to a given refinery when needed.
- Equipment rental helps cut cost of shops and mechanics. Most companies should use contract maintenance to some extent. If good balance between company and contract maintenance can be struck, it is possible to move either way to take advantage of wage differentials.
- In areas where there are several refineries, the plants could use common maintenance forces. Large refineries which do their own maintenance run about 50-50, ratio of maintenance to nonmaintenance personnel. Pooling the maintenance forces would cut down on over-all maintenance employes.
- It may be economical to eliminate costly water systems and go to 100% air cooling. Three new European refineries are following this pattern.

"Economical plant operation begins done to design more precisely,

Automation Progress

Greatest progress in the field of instrumentation and automatic control is being made with process stream analyzers. All of the men interviewed confirmed this widespread trend in the industry. One plant has 50 analyzers now and will have 200 within two years.

By and large, the analyzers are used as simple recorders, to bring stream analyses to the attention of the operator. He in turn makes the necessary process control adjustments. A few analyzers are used to reset control points on conventional instruments.

Basic measuring devices, already improved, need to be improved still more before universally good stream analyses can be obtained. Too, some of the analyzers on the market are not yet fully developed for day-in-and-day-out service in a plant exposed to all kinds of weather. Additional development and redesign are now going on to adapt some of these instruments.

Stream analyzers are the key to im-

provements in process operation. Instantaneous indication of analyses will show effects of changing variables. These effects have been masked up to now because of lags and changes of other variables during lag time.

The process chromatograph is almost universally applied in refineries, and viscometers, colorimeters, sulfur analyzers, and refractive index indicators follow closely in degree of application. Instruments based on measurement of dielectric constants are quite versatile. Some refiners reported no utilization of distillation instruments as yet. However, one interviewee said that his company doesn't depend on the laboratory for any analyses on control of fractionators. The company installs enough stream analyzers to provide all necessary control information for the operator.

Computer control is slow. Plans for automation beyond the stream-analyzer stage are much more indefinite. Most respondents cannot justify computer control of any processes. Several reported that thorough process studies have been made to evaluate computer-control possibilities. The increased understanding of the processes brought about by the studies have enabled healthy increases in efficiency to be brought about by more enlightened use of conventional instrumentation.

One company is installing electronic instrumentation almost exclusively, both to enable the use of longer distances between control point and control room, and to ready processes for ultimate computer control. The experts all agree that in the long run widespread use of computer control is inevitable.

Opinion is sharply divided on the benefits of data logging. One company installed data-logging facilities on crude units. Now, several years later, other crude units are being built without data logging. It simply hasn't proved to be worth while, the company spokesman said.

Another man reported that what makes sense for the present, as far as the thinking in his company is concerned, is the application of data logging with alarm systems built in. The inside man can monitor more equipment, and the outside man can also cover more ground.

Most of the men interviewed agreed that computer control is likely to start small, with certain critical portions of a process being tackled first. One man said that there are situations which justify current application of smaller units. The criteria are: (1) the computer must be installed on the critical function of the plants, and (2) it must be simple enough that the operator can take over control easily in an emergency.

No manpower saving. The experts agreed to a man that automation savings will not accrue due to decreased manpower. Rather, increases in efficiency, yields, or profitability must justify the capital outlay.

Some laboratory people will no longer be needed, but additional technicians will be required to keep the new instruments operating. And progress in instrumentation will be geared somewhat to the users' ability to get people properly trained. The training period is 2 to 5 years.

One man characterized present applications of computer control as "strictly exploratory," but they will pay for themselves in advertising value, he said.

Company-wide automation. One man felt that the next step which should be taken in his company is the tie-in of all refineries using skeleton models to give answers to geographical, marketing, and production problems. These models can be beefed up at the individual refinery for use in process control. Then, ultimately, one large control computer will be able to handle all the units in a given refinery by multiplexing from one unit to the next, he said.

with unit design, and much is being without costly excess capacity"

Other Developments

One of the experts was most critical of himself and others in refining development. The whole industry must sharpen its research techniques to assure that work is done on problems which will assure some fruitful results.

Too often we spend time, money, and manpower on projects which are marginal at best, even if the objectives are obtained 100%. If some company develops a process, all the rest of us jump in with big research and development programs to try to find a little different way of doing it or to improve it a bit, he said.

It's high time that some of us spend some time just looking at the wall and thinking some original thoughts which can be implemented in the laboratory and pilot plant, he said.

Other engines. The present automobile engine is here to stay, at least for the foreseeable future, the men believe. New engine designs are needed to help alleviate some of the present problems. One of the men strongly thinks exhaust-gas cleanup will come about from better engine design. The catalystic-muffler approach is doomed to failure, due to cost and design problems, he thinks.

While the experts don't expect inroads on the piston engine for cars, they are looking to much increased use of gas turbines as refinery drivers for a number of purposes. The free-piston engine is also undergoining close scrutiny.

Small cars. The men see a trend toward small cars and "transportation" cars. The car has lost its significance as a status symbol, and car owners are taking a fresh look at an expenditure which takes up to 35% of the family income. People are beginning to realize that an automobile is just transportation and plan to spend less money on it.

One man suggested that this may ultimately mean the marketing of one grade of gasoline. And, he said, it might be better all the way around, for refiners and consumers alike.

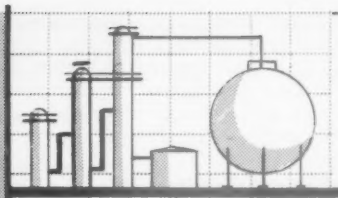
Shale oil. Very pertinent in the thinking of some of these men is the question, "When is shale oil coming in?" Oil from shale is still more expensive than crude oil, but the price of crude doesn't pay present oil-finding costs. And these costs are going up all the time.

U. S. prices are currently held down by Middle East prices. These prices will go up until they get competitive with U. S. prices because the Middle East governments want more oil money and will eventually push the prices up as high as they can. Ultimately, the ceiling prices of all crudes will be set by the price of shale, one expert said.

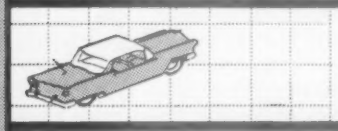
Gasoline additives. In the normal gasoline blend in the United States, TML is 35 to 36% more costly than TEL, one man said. Thus, TML cannot be justified at present in any except special situations. Neither will there be any rush to manganese and other recently developed additives, he thinks.

Quite possibly, TML may have more application abroad, because it shows a 3 to 4 higher road octane number for compacts and foreign cars when used with typical foreign gasolines, he said.

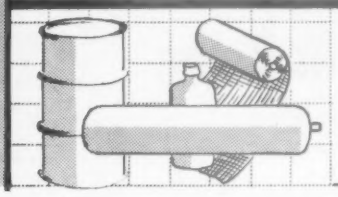
THESE THREE TRENDS HAVE MARKED THE LATE FIFTIES



Refinery-yield trends show that, while motor fuel now represents an average of about 45% of crude runs, the same as it was 20 years ago, residual-fuel yields have dropped from about 24% of crude runs to less than 12% during the same period.



Motor-fuel quality as measured by octane rating has increased tremendously in the past 8 years, with regular and premium fuels up about nine octane numbers each.



Refinery flexibility will increase, as dictated by market demands and refinery economics, to make "new" products—such as petrochemicals—to improve "old" products, and to shift from one to another as seems most advantageous from time to time.

What's ahead for the sixties?

It's a decade of promise, but growth will be selective

THE OUTLOOK for the 1960's is one of bustling activity and dynamic growth. In the development of process technology and in the construction and expansion of refineries, the definite trend will be toward making greater volumes of higher-quality motor fuels, jet fuels, and petrochemicals.

Specialty products will assume a growing importance in the scheme of the refiner—but not to the exclusion of conventional fuel products.

Growth will be selective, however, and the refiner must be up to date in the facilities he retains and be equally selective in processing ventures he undertakes, in order to realize the greatest return on investment.

Motor Fuels

We are all aware of the ability, ingenuity, and initiative of engineers and scientists who have developed such popular catalytic processes as cracking, reforming, hydrogen treating, polymerization and condensation, alkylation, isomerization, and their supporting techniques.

Some of these processes were unheard of 20 years ago and others were only an idea yet to be satisfactorily commercialized as recently as 5 years ago. Needless to say, these processes will continue to be the mainstays of refinery flexibility, but improvements are expected.

Demand increase. Considering the rapid increase in the number of motor vehicles consistent with the growing population and expanding economy, UOP's experts in petroleum economics believe a motor-fuel demand approaching 6 million barrels per day by the end of this decade is plausible. This comes about with consideration of the ever-increasing number of multicar families, the continued dispersal of industry, commerce, and population, and the highway program.

To meet a demand of this magnitude suggests increased catalytic cracking capacity, operating in the 67 to 70% conversion range. With octane requirements averaging four to six numbers higher than at present, it is reasonable to project that the industry will meet these higher values by employing, for the most part, presently known processes.

Refiners undoubtedly will resort to more severe reforming, use alkylation and butane isomerization to increase octane rating and alleviate sensitivity problems. And they will add pentane and hexane isomerization to minimize "dilution" of high-octane materials with low-octane normal paraffins.

Multigrades. A controversy now exists as to future prospects for a third grade of motor fuel; namely, the so-called "superpremium" fuels which currently range in octane rating from 100 to 103 (Wiese scale).

There are those who argue that, if the average octane rating of pre-

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mium fuels increases by four numbers, it will equal the top of the present superpremium range.

Moreover, the public already has shown a strong interest in the "compact" cars which do not require even today's premium gasoline for adequate performance, and there appears to be significant public sentiment also for increased fuel economy. Reports say that the octane requirement for American-made compacts will increase. Therefore, say the two-grades-only proponents, what is the justification for a third grade?

On the other hand, multigrade proponents argue that the buyer should not be forced to buy octane numbers that he does not need. Thus, there should be at least a regular, a premium, and a superpremium to satisfy the various elements of the car population.

Moreover, they point out, experimentation continues in the development of automobile engines having compression ratios—and thus octane requirements—vastly above anything on the road today.

Furthermore, compacts are a new factor in the market and may very well develop to require a fuel different from anything now on the market. Hence, they conclude, there always will be a need for three or more grades of fuels.

In the author's opinion, there are neither sufficient facts nor an adequate backlog of experience to resolve this controversy to the extent that a defensible forecast can be made, other than an expectation of an upward trend in engine-fuel requirements.

Over-all Yield Trends

The economic outlook for black oils in the United States indicates that overabundance of these fuels could continue to impose grave problems on some segments of the refining industry. Under present conditions, our economic studies show that the potential surplus of residual fuels could exceed a million barrels per day by 1968.

It therefore appears that a further reduction of residual yield on crude runs is imminent. Refinery black-oil production may need to drop substantially during this decade. To ease the problem of imbalance in some areas of the country, installation of additional coking and new hydrocracking processes have merit.

Upgrading residues. The conversion of these heavy materials to lighter hydrocarbons by coking automatically creates a potential pool of hydrocarbons spanning the gasoline and middle-distillate boiling ranges, and furthermore creates additional volumes of propylene and butylenes.

"Cleaning up" these materials so that they will be satisfactory as charging stocks to catalytic reforming and catalytic cracking will require more hydrogen-treating capacity. To consume the additional volume of light olefins will require more alkylation capacity and related facilities.

Hydrocracking presumably will yield a product which will not need further hydrogen treating. The gasoline-range cut probably will require further upgrading, such as by catalytic reforming. The middle-distillate portion likely will need no further treatment. It would seem that there will be no increased production of light olefins, paraffins appearing instead.

In essence, then, the projected 6-million-barrel per day motor-fuel demand will be met with higher conversion and more selective catalytic cracking, more severe reforming, and conversion of olefins to alkylate.

Coking, hydrocracking, and isomerization will supplement these basic processes and will provide a substantial portion of the increased volume of gasoline-boiling-range hydrocarbons required. Without converting the black oils, an increase in crude runs merely to meet the increased gasoline volume would be inevitable.

Jet fuel. With over-all civilian and Defense Department demands for jet fuel continuing to increase, the long-term outlook for this phase of the refiner's business appears quite favorable. Jet fuels of greatly superior quality to current products will be required and paraffinic fuels for this purpose will reach a much higher production level as prices improve.

Paraffins, particularly normal paraffins, are characterized by high "luminosity numbers"; i.e., less-luminous flames than are produced by other hydrocarbons. More-luminous flames cause the engine parts to become hotter with no increase in the rate of heat release and without gain in effective thrust developed by the engine.

Thus, the use of a fuel which burns with a less-luminous flame causes a significant increase in performance by permitting a greater heat release (higher efficiency) for the same number of pounds of fuel consumed, and a decreased tendency for carbon deposition on engine parts which, in turn, is reflected in lowered maintenance requirements.

Paraffinic fuels also release a greater quantity of heat per pound of fuel burned than conventional fuels. Since commercial jets are limited in the amount of weight they can carry, this is an important consideration. Paraffinic fuels occupy more space per pound than current conventional fuels, but this is not considered a limiting factor with commercial jets.

The appearance of commercial processes for the separation of paraffins from aromatics, and the separation of isoparaffins from normal paraffins should allow the inclusion of these more desirable materials in jet fuel to a greater extent in the coming decade. Incorporation of these separation processes into the refiner's operations also will allow him to produce higher-quality motor fuel, since the lower-quality paraffins will be removed from the gasoline pool.

Udex and Molex processing of reformates and straightrun naphthas will be commonly used to meet increased demands for these specialty fuels.

Petrochemicals

Progress in petrochemicals in the 1960's primarily will be in fibers, plastics, and elastomers. Although ethylene still is holding the top spot among basic petrochemical raw materials, propylene and butylenes are well on their way toward broadening chemical prominence. Aromatics, already important, constitute another promising group for growth potential.

Significantly, several large chemical companies today are seeking large-volume sources of feed stocks, both for old products and for new synthetics still in the development stage.

In order to supply these feed stocks, refiners will find themselves employing processes on an increasing scale which have been heretofore most commonly used only in the chemical industry, as well as expanding and applying to new uses such processes as extractive distillation, dehydrogenation, hydrogenation, alkylation, and isomerization.

The importance of petrochemicals is such that refiners may increasingly base their choice of processes on those which offer the most promise as producers of byproducts desirable as petrochemical raw materials.

Benzene. One of the most important of these is benzene. Production of this aromatic has doubled in the last decade and shows promise of substantial growth in the decade ahead.

Although most of the benzene produced 10 years ago was derived from coke-oven operations, petroleum refiners now have become the principal suppliers. This has come about partially because the coke-oven operators could not supply enough to meet demand and partially because petroleum benzene was markedly higher in purity.

WHAT'S AHEAD

Through Platforming and Udex, refiners are able to supply benzene, toluene, and xylenes of high purity and in virtually any quantity which market demand may require.

Coke-oven operators, on the other hand, while not now limited by quality, still are limited in the quantity of aromatics they can supply by the volume of coke they process which, in turn, is controlled by the level of steel production.

In the future, high-purity benzene will be in a particularly advantageous position because of the advent of such processes as Hydrar, for the production of cyclohexane, and Alkar, for the production of ethylbenzene. Both of these petrochemical intermediates may be produced in extremely high purity.

The principal end use of benzene is in the production of ethylbenzene for styrene manufacture. In the past, most of this material was made by the alkylation of a concentrated ethylene stream with benzene. However, dilute ethylene streams from fluid catalytic cracking operations may now be used for alkylation without further concentration. Since the ethylene purification step is eliminated, this method should find more extensive application.

Another use of high-purity benzene is in the production of cyclohexane. Using benzene of high purity, cyclohexane of equally high purity is produced.

Toluene. Toluene should not show as high a growth rate in the future as benzene. At present, much of this material is blended into premium motor fuel and aviation gasoline, since an oversupply exists insofar as purely petrochemical usage is concerned. In the future, however, the refiner may obtain a greater measure of flexibility by being able to convert excess supplies of this material into benzene.

Xylenes. Future growth in xylenes will be in chemical usage for the various isomers; i.e., terephthalic acid from p-xylene, isophthalic acid from m-xylene and phthalic anhydride from o-xylene.

Naphthalene. Another application which may be of considerable interest to refiners in the future is the production of naphthalene from heavy platformates. The main end use of naphthalene is in the production of phthalic anhydride. For this purpose it usually has a cost advantage over o-xylene. Naphthalene has been supplied to the chemical industry previously by coke-oven operators, but supplies have been unreliable due to strikes and the erratic demand for steel.

Ethylene. The refiner also may get into the ethylene-manufacturing field by cracking propane, naphtha, and/or other hydrocarbon streams. In this way he will be able to obtain more ethylene for ethylbenzene production or polyethylene manufacture.

Propylene. Byproducts of such a cracking operation include propylene, which could be used for the production of cumene, tetramer for detergent alkylate, or polypropylene. This latter material, originally introduced by Montecatini, is gaining wider acceptance in the United States and is challenging polyethylene for some applications.

Other byproducts of cracking include butadiene, which is used in synthetic rubber (SBR), or the newer polybutadiene rubbers. Aromatic liquids produced in naphtha pyrolysis may be processed to recover benzene, toluene, and xylenes by a combination of two-stage hydrogen treating and solvent extraction.

Propylene produced in petroleum refineries may be polymerized to yield numerous chemical raw materials. Presently, the most important of these is propylene tetramer, which is used in the manufacture of detergent alkylates. Others include tripropylene, used in detergents and in making decyl alcohol by the Oxo process; and heptenes, a copolymer of propylene and butylene from which octyl alcohol is made, again by the Oxo process.

We have summarized a number of areas wherein the refiner may achieve flexibility by the production of petrochemical raw materials. Persistent research will continue to culminate in products and processes which are often superior with respect not only to particular technical characteristics, but also to economic considerations.

Addition of these specialty capacities to improve refining economics and the strengthening competition for markets is being reflected in new construction both here and abroad. Moreover, there is increasing use of linear programing in conjunction with electronic computers to optimize refinery and petrochemical-plant operations, as well as to employ them in direct-control applications.

Optimization

An increasing number of refiners have problems in optimizing refinery operations. These problems involve four general areas for solution:

1. Operation of combinations of presently installed units to maximize profits.

2. To show which of several alternative installations will improve payouts and earnings consistent with present and future markets in specific areas.

3. To aid in policy decisions concerning marketing and transportation considerations.

4. To improve refinery cost-accounting procedures.

In the future, we may no longer see the periodic gluts of certain products in the market place, because advanced forecasting techniques in conjunction with computers can forewarn the refiner in sufficient time to get his house in order.

Anticipation by the refiner of changes in demand for products will assist him to smooth out the violent swings from scarcity to abundance. This may take the form of shifting the emphasis on specific products, cutting back on crude throughput, or other degrees of flexibility possessed by the specific refinery and its markets.

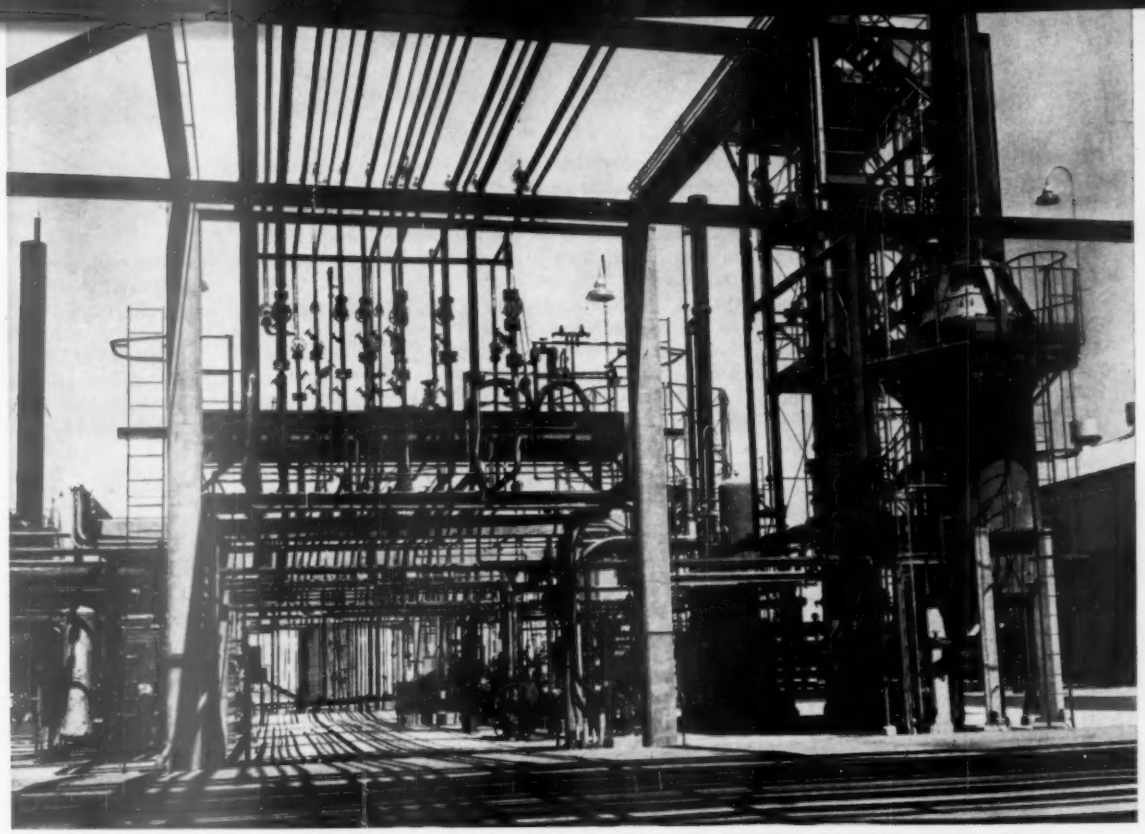
Already refiners are beginning to experiment with computer circuitry in conjunction with conventional electronic instrumentation, as well as with equipment formerly found only in research laboratories, to bring process control closer and closer to complete automation.

Thus the usual pressure, temperature, and flow-instrument outputs may be fed into the program of a computer, together with outputs from various analytical instruments—such as spectrometers or contaminant monitors—to appropriately readjust process conditions to continuously maintain optimum yield of specification product.

Given external data from a computer programed to optimize over-all refinery production, and suitably modified by human judgment, operations that have been heretofore impossible may become a part of refinery routine.

The general field of computer control and optimization offer great promise to the refiner by effecting the most economic and profitable operation for his particular circumstances. After all, in the future as well as in the past, each refiner is a special case unto himself, operating in a unique environment. Hence no generalization, however complete, will be universally or entirely applicable to a specific refiner.

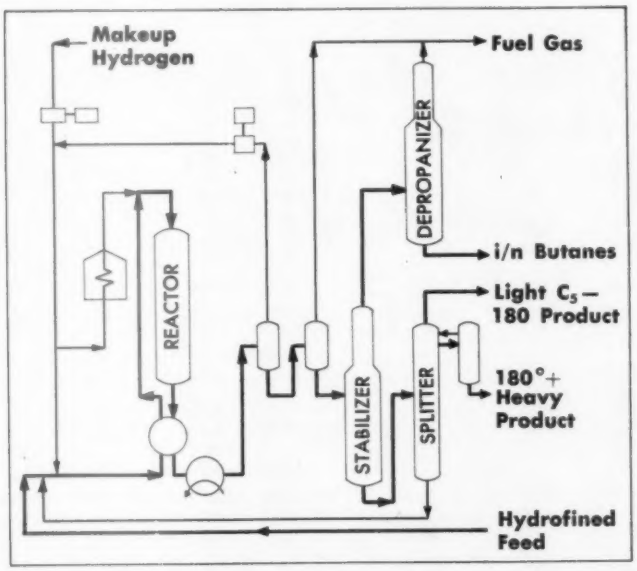
The refining industry provides an essential service to the welfare of the country. To warrant the risk and effect of continuing to provide this service in the long run, profits of the industry must be adequate. Our objectives, as we have pointed out in this article, are to enhance the profit-making potential of the industry by development of new processes, techniques, and services to the refiner.



THOUSAND-BARREL PER DAY ISOCRACKER at the Richmond, Calif., refinery of Standard Oil Co. of California.

Performance of Socal's commercial unit shows . . .

Isocracking turns in good performance in upgrading middle distillates



HYDROFINED FEED is hydrocracked and separated in conventional equipment. Fig. 1.

BY D. H. STORMONT
West Coast Editor

A 1,000-BBL. Isocracking plant has been in operation since last July at the Richmond, Calif., refinery of Standard Oil Co. of California, Western Operations, Inc.

Yields and specifications of gasolines produced from a variety of charge stocks very closely approximate pilot-plant yield structures. Versatility and operating simplicity of the new catalytic hydrocracking process, developed by California Research Corp., also are being borne out.

Process description. Isocracking is a selective low-temperature cracking process designed to convert a wide range of middle-distillate stocks to high yields of high-octane gasoline. Valuable byproducts include isobutane and isopentane in substantial volumes. Virtually no fuel gas is produced (OGJ, Oct. 26, 1959, p. 48).

As shown in the simplified process flow diagram (Fig. 1), the feed stock is pretreated in a hydrofining unit to strip out sulfur and other objectionable compounds. The hydrofined charge is then hydrocracked in conventional equipment which includes a reactor, hydrogen furnace, and appropriate distillation facilities to separate the products and recycle.

Reactor temperatures in the range of 400° to 700° F. are used, substantially below those in other distillate-upgrading processes. Pressures employed vary according to the feed stock and conversion rate, ranging from 500 to 2,000 psig.

The process can be operated either to extinction recycle for complete conversion of gas-oil feeds to gasoline, or it can be operated on a once-through basis to produce a gasoline stock and a distillate with a boiling point just above gasoline, i.e., synthetic jet fuel. Conversion rate in the commercial single fixed-bed reactor has been in the range of 58 to 62% per pass.

California Research, subsidiary of Standard of California, has not revealed the nature of the catalyst used. Performance of the catalyst in the Richmond plant, however, indicates it is rugged and long lived. It showed little loss in efficiency during more than 4,000 hours of plant operation. Its cost is much less than that of conventional noble-metal reforming or isomerization catalysts, Cal Research officials have stated.

How it fits into a refinery. Isocracking provides a valuable new tool to improve over-all product realization and balance refinery operations. It can provide a new route to octane improvement, reduce pool olefin content, decrease pool sensitivity, and control gasoline volatility.

Most importantly, however, the process permits a refiner to get more gasoline out of a barrel of crude oil, and to do it without suffering stock losses to gas and coke. With Isocracking, there actually is an over-all increase in liquid product yields from the crude-oil barrel.

Light distillates from catalytic and thermal units, including coking are converted to 100% yields of low-sensitivity gasoline blend stocks. Kerosine, jet fuel, diesel, and stove-oil fractions are typical feed stocks.

It also can be employed to upgrade marginal gasoline stocks, such as paraffinic raffinates or heavy catalystic and thermal gasolines. Distress straightrun middle-distillate stocks, such as kerosine, stove oil, and diesel oil, likewise can be converted to high-octane gasolines.

Table 1 gives new yield structures on four typical feeds. The pilot-plant data are shown on the basis of a 400° F. cut-point product. At lower cut points, the amounts of isobutane and light product increase and heavy product decreases. However, the total butanes-plus yield stays about the same.

That the process will be of particular value in coking refineries is reflected in the third column of the table. As shown, a light coker distillate feed stock gave a 99.9% (volume) yield of product. And this high conversion was accomplished with a

TABLE 1—FEED AND PRODUCT INSPECTIONS FROM FOUR TYPICAL CHARGE STOCKS (PILOT PLANT DATA)

HYDROFINED FEED STOCK	California catalytic cycle oil		West Texas catalytic cycle oil		California light coker distillate		California light SR gas oil	
Gravity, °API	30.8		30.3		35.1		33.2	
ASTM D86 or D158, °F.								
5	379		368		401		447	
10	457		442		416		473	
50	511		491		474		517	
90	578		554		553		587	
E.p.	637		597		603		641	
Composition, liquid vol. %:								
Paraffins and naphthenes	57		51		71		68	
Aromatics	43		49		29		32	
	100		100		100		100	
Yield, vol. % of raw feed	102.8		101.5		104.4		99.3	
TYPICAL PRODUCTS								
Yields, based on hydrofined feed:	Wt. %	LV %	Wt. %	LV %	Wt. %	LV %	Wt. %	LV %
C_1	0.01		0.01		0.01		0.01	
C_2	0.20		0.22		0.22		0.08	
C_3	3.00		3.10		3.80		2.30	
Isobutane	6.50	10.6	6.90	10.7	8.80	13.4	6.70	10.1
n-Butane	3.80	6.2	3.90	5.8	4.20	6.2	3.80	5.5
C_5+ Isocrackate	89.00	101.5	88.20	101.6	84.90	96.3	89.10	101.6
TOTAL	102.50		102.30		101.90		101.99	
C_4+ Isocrackate	99.30	118.3	99.00	118.1	97.90	115.1	99.60	119.3
Yields based on raw feed:								
C_5 + Isocrackate		105		103.1		99.9		102.7
GASOLINE STOCKS	C_5-180° F.	180-400° F.	C_5-180° F.	180-400° F.	C_5-180° F.	180-400° F.	C_5-180° F.	180-400° F.
Yield, vol. % C_5+	27	73	27	73	29	71	29	71
Inspections								
Gravity, °API	83.4	47	82	46.4	83.2	47.1	82	51.5
Octane rating:								
F-1 at 3 ml. TEL	99	88	†99	89	99	87.0	100	79
F-2 at 3 ml. TEL	100	82.5	†100	84	100.7	84.3	100.7	76
F-1 at 3 ml. TEL*		*101.7		*102.7		*100.0		*97.8
Composition, LV %:								
Paraffins	88	31	†87	36	85	28	80	41
Naphthenes	9	39	†10	26	13	50	16	42
Aromatics	3	30	†3	38	2	22	4	17
	100	100	100	100	100	100	100	100

*After platinum reforming to 91 vol. % C_5+. †Octanes estimated.

gas loss (propane and lighter) of only about 4%.

Richmond plant operations. The 1,000-bbl. Isocracking unit at Socal's Richmond refinery has been operating on a light cycle oil from a 40,000-bbl. FCC unit. The oil, ranging from 20° to 29° gravity, is fed directly into the hydrofiner pretreating section ahead of the hydrocracking unit.

Both the hydrofiner and Isocracker operate on makeup hydrogen obtained from nearby catalytic reformers. The Isocracker product stream from the unit is reformed in the cat reformers before being blended into finished motor fuels.

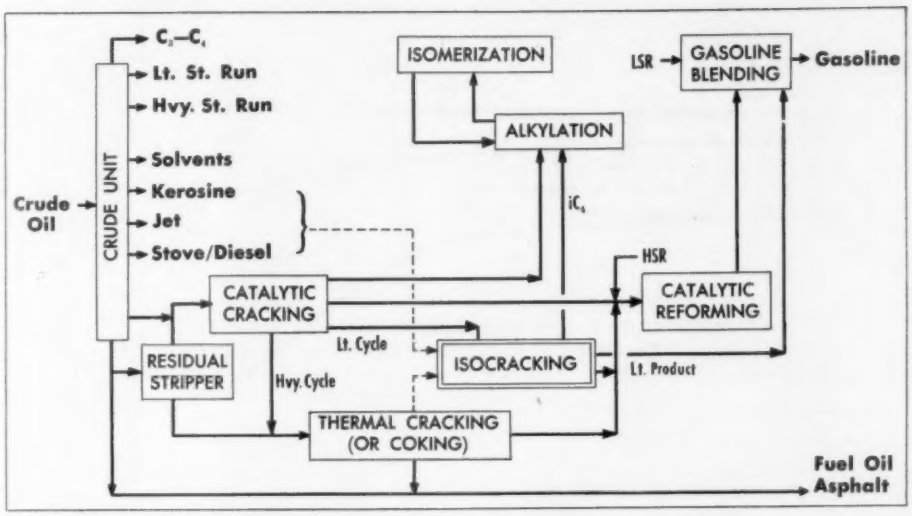
Plant yields for three different operating periods are given on Table 2, along with pilot-plant data obtained with a similar charge stock. Table 3 gives the product inspections for one period of plant operation, and compares them with similar results from the pilot plant.

Despite the usual difficulties in getting good material balances and analyses around a commercial plant, the comparisons show the pilot-plant data are being duplicated in the Richmond plant. This was true throughout the more than 4,000-hours operation of the commercial plant.

Minor differences are shown in the light-product distribution given in Table 2. Some of this is accounted for in the differences in gravity and aromatic contents of the commercial and pilot-plant feeds.

Another reason is that some methane and ethane are contained in the cat reformer hydrogen used in the Isocracker. Because the net gas make from Isocracking is so low, and the plant gas yields shown were arrived at by difference, material balances as often as not result in negative methane and ethane contents. Much more important is the fact that the propane-and-lighter gas yield is generally less than 4%.

Since the process was announced last October, Cal Research has prepared numerous estimates of Isocracking yields for refiners throughout the nation. No new units have been announced, but Standard of California is planning other plants.



HOW ISOCRACKING FITS into the refinery. It can convert a wide range of middle-distillate stocks into high-octane gasoline. Fig. 2.

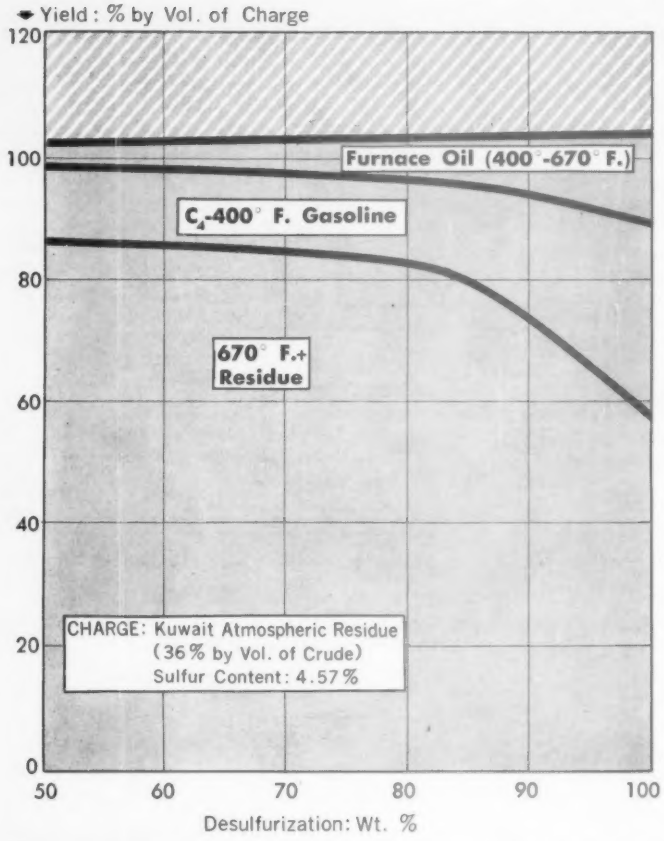
TABLE 2—COMPARISON OF COMMERCIAL AND PILOT PLANT YIELDS, USING LIGHT CATALYTIC CYCLE OIL AND FEED

	Richmond plant operating period			
	1	2	3	Pilot plant
Hydrofined feed inspections:				
Gravity, °API	31.7	32.0	27.2	30.6
Aniline point, °F.	113	118	77	107
D-158 distillation:				
Start	384	398	374	404
10%	446	439	440	447
50%	483	479	477	480
90%	527	530	521	519
E.p.	569	570	568	569
Composition, vol. %:				
Paraffins and naphthenes	62	63	51	55
Aromatics	38	37	49	45
Yields, wt. % of fresh feed:				
C_1	−0.71	0.36	−0.46	0.01
C_2	−0.47	0.68	−0.33	0.2
C_3	1.58	2.79	1.98	3.1
iC_4	7.6	10.3	7.1	7.2
nC_4	3.3	2.6	4.2	4.2
C_5-180	24.96	20.83	24.74	21.7
180-403	67.31	65.51	66.29	66.0

TABLE 3—COMPARISON OF PRODUCT INSPECTIONS, COMMERCIAL VERSUS PILOT-PLANT OPERATIONS USING LIGHT-CYCLE-OIL FEED

	Plant operation period 3		Pilot-plant operation	
	C_5 − 180° F.	180° F. +	C_5 − 180° F.	180° F. +
Gravity, °API	82.9	45.9	82	46.6
Aniline point, ° F.		72.5		84.5
Composition, liquid vol. %				
Paraffins		20	87	29
Naphthenes		45	10	40
Aromatics		35	3	31
Distillation (ASTM) ° F.				
Start	95	223	108	223
10%	107	241	111	245
30%	112	250	118	261
50%	120	272	125	282
70%	134	299	136	311
90%	152	339	159	352
E.p.	168	385	180	385
Octane numbers*				
F-1 clear	88.0	80.0	86	76
F-1 + 3 ml. TEL	*99.6	*93.0	99	89.5
F-2 + 3 ml. TEL	*100.3	*85.0	100	84.3

*Estimated.



PRODUCT DISTRIBUTION as a function of desulfurization in the Gulf HDS process. Fig. 1.

HDS residual processing reduces viscosity while increasing quality

Product can be sold as a low-sulfur-content fuel oil in either foreign or domestic operations, or a good yield of high-quality cracking stock can be removed in plants stressing gasoline production

SULFUR-REMOVAL from residual fuel oils can now be made profitable with the use of Gulf HDS processing. In one of its applications this process can

. . . **Reduce fuel-oil problems** by producing better-quality oils in lower yields.

BY H. BEUTHER, R. A. FLINN, AND B. K. SCHMID
Gulf Research & Development Co.

. . . **Boost distillate production** at the same time.

. . . **Lower metal contamination** and carbon residue in all products.

Generally two applications of the process cover most refinery requirements. These are: (1) complete conversion of the residue to eliminate heavy-fuel-oil production; and (2) treating the residue to remove contaminants. This reduces viscosity, so that a lower volume of a higher-quality residual fuel oil is produced.

The first type of HDS processing has been discussed in a previous article: It requires pressures in the range of 2,000-3,000 psig. and converts residues entirely to premium cracking stocks plus a significant amount of lighter distillates. Metals and sulfur are almost completely removed (95-100%), and carbon residue is reduced drastically (80-90%). Since the bulk of the product is premium cracking stock, the higher-pressure version is most suited to refineries where gasoline is the prime product.

The second general use for the HDS processing of residuals, that of reducing viscosity while increasing quality, is carried out from 500 to 1,000 psig. The residual product can be sold as low-sulfur-content fuel oil in either foreign or domestic operations, or, instead, a good yield of high-quality cracking stock can be removed from the product in those refineries stressing gasoline production.

In the latter case, the residual fuel-oil product is still low in sulfur, since the resulting cracked cycle oils that are normally blended with residue to make fuel oil are low in sulfur, as is the residue itself. This points up another aspect of residue desulfurization.

The distillate portions in the hydrodesulfurized product are also quite low in sulfur, and processes to which they are subsequently charged yield higher-quality products. Catalytic cracking desulfurized gas oils, for example, gives higher-octane gasoline and low-sulfur furnace oil. Thus, the quality benefits of residual desulfurization are felt throughout a refinery.

In the past, removal of sulfur from residuals has been considered a fine objective, but impractical because of the low selling price of residual fuel oil. Thus, inability to add any significant price advantage to the product to pay for improved quality has hindered desulfurization processes.

Recent developments in HDS processing of residues, however, allow the refiner to make sulfur removal from residues a profitable operation. The high level of desulfurization possible with HDS causes a simultaneous conversion of a large portion of the residue to lighter products.

Heavy residues, which before processing require large quantities of cutter oil to make suitable fuel oils, not

"The operation is similar to that of furnace-oil desulfurization."

only meet fuel-oil-viscosity specifications after HDS processing but also produce a quality furnace oil and some gasoline. The reduction in viscosity is accompanied by hydrogenation which improves burning characteristics and reduces burner deposits. Such a result is in contrast to thermal treatments of residues, which tend to cause large molecules to become larger and more inclined to poor combustion properties.

The HDS process uses a fixed bed of catalyst, moderate pressure and temperature, and operates continuously for several months. At the end of that time, the catalyst can be regenerated. The operation is similar to that of furnace-oil desulfurization.

Onstream time is, of course, shorter than with lighter distillate stocks but the conditions and catalyst are such that the difference in onstream time is not great. The problem of metals on the HDS catalyst has been minimized by development of techniques for selective removal of such contaminants. For all operations discussed in this paper, an onstream period of several months is possible prior to regeneration.

Processing Vacuum Residues

Refineries in this country generally practice catalytic cracking of straight-run heavy gas oil. As a result, a vacuum residue remains as one of the products. In the case of Kuwait crude, vacuum residue amounts to about 18% by volume of the crude. This residue contains 5.5% sulfur and requires a quantity of furnace-oil-range cutter oil equal to about half of its own volume. The net result is that about 27% of the crude input to a Kuwait-crude refinery comes out as No. 6 fuel oil containing about 4% sulfur.

Using the Gulf HDS process at 500 to 1,000 psig. to desulfurize this vacuum residue gives results such as are shown in Table 1. The vacuum residue yields about 63% of its own volume as a 670° F. + residue having the viscosity of No. 6 fuel oil. This fuel oil contains only 1.0% sulfur and 5 p.p.m. vanadium. Thus, residual-fuel-oil production is reduced from 27% on crude to 12%, and the quality of product is greatly enhanced.

As the residue is desulfurized and reduced in viscosity, distillate products can be obtained. The yield of these depends upon the severity level used, and it is possible to minimize distillate production to obtain largely a desulfurized residual fuel oil.

At conditions giving a 63% yield of 1.0% sulfur fuel oil, a distillate yield of 16% gasoline (C_4 – 400° F.) and 25% furnace oil (400°-670° F.) is obtained. The gasoline is highly desulfurized and is somewhat better than virgin naphtha from the same crude in its reforming characteristics. The furnace oil is also low in sulfur, about 0.2%, and has a diesel index of about 44.

The effect of applying the HDS process to Kuwait vacuum residue is to increase light-distillate yield by about 15% on crude, counting the savings in cutter oil, and to reduce No. 6 fuel oil from 27% to about 12% on crude. Residues having sulfur contents less than that of Kuwait can be processed to get the same percentage removal at similar conditions.

Processing Atmospheric Residues

In certain refinery applications it is desirable to treat a longer residue than that obtained from a vacuum still. At the mild conditions used for residue desulfurization, it is not now practical to get enough conversion of such a residue to allow use of the total product as a normal catalytic cracking charge, as has been described with more severe HDS processing.[1] However, it is possible to get the appreciable residue conversion described in the previous section together with a substantial upgrading of the virgin catalytic cracking charge.

In an application where catalytic cracking is not widely used, such as in some foreign refineries, atmospheric residue can be HDS-processed to yield reasonable quantities of light distillates along with a low-sulfur heavy fuel oil.

TABLE 1—MILD HDS-PROCESSING OF A VACUUM RESIDUE

Product Yields Vol. % of charge	Charge	Products
% Gasoline (C_4-400° F.)		16
% Furnace oil (400°-670° F.)		25
% Residual oil (670 °F.+)		63
Product Inspections		
Gasoline		
°API	Kuwait	54.2
% Sulfur	vacuum	0.04
% Aromatics	residue	18
% Naphthenes	(18% by vol. of crude)	20
Furnace Oil		
°API		33.1
% Sulfur		0.17
Aniline point: °F.		132
Diesel index		43.6
Residual Oil		
°API	5.5	12.6
% Sulfur	5.5	1.0
Viscosity, S.U.s.		
at 100° F.	.....	7,100
at 210° F.	22,130	143
% Carbon residue (Conradson)	23	14
Vanadium: p.p.m.	102	5

TABLE 2—MILD HDS-PROCESSING OF AN ATMOSPHERIC RESIDUE

Desulfurization: %	Charge	67	80	93
Product Yields: vol. % of charge				
Gasoline (C_4-400° F.)		4	7	11
Furnace oil (400°-670° F.)		13	14	23
Residual oil (670°-F.+)		85	82	70
Product Inspections				
Gasoline				
°API	Kuwait	52.9	52.3	53.2
% Sulfur	atmospheric	0.06	<0.04	<0.04
% Aromatics	residue	15	19	19
% Napthenes	(36% by vol. of crude)	16	18	19
Furnace Oil				
°API		32.3	31.6	30.4
% Sulfur		0.6	0.3	0.2
% Aniline point: °F.		128	126	128
Diesel index		41.4	39.8	38.9
Residual Oil				
°API	10.9	15.9	17.4	19.1
% Sulfur	4.6	1.6	1.0	0.4
Viscosity, S.U.s.				
at 100° F.	10,300	5,300	4,150	1,420
at 210° F.	840	169	130	86
% Carbon residue (Conradson)	13.9	9.2	7.7	5.8
Vanadium: p.p.m.	63	18	6	0.5

Both of these applications have been studied.

The results obtained by HDS processing a 36% Kuwait atmospheric residue containing 4.6% sulfur at 500-1,000 psig. are shown in Table 2. It is practical to get desulfurization levels up to about 95% with this charge, and the degree of conversion and quality improvement can be related directly to per cent desulfurization.

At about 80% desulfurization, the yield of light distillates is about 21% by volume of the charge. That part of the product boiling above 670° F. has a viscosity well below the specification for No. 6 fuel oil and contains about 1% sulfur. By decreasing severity to obtain about 67% desulfurization, light-distillate yield is brought to 17%, and the 670° F. + product, which still is slightly less viscous than No. 6, contains 1.6% sulfur. An increase in the desulfurization level to 93% gives 34% gasoline-plus-furnace oil and a 670° F. + fraction of very low viscosity.

Fig. 1, plotting desulfurization versus the yield of various fractions, allows interpolation of these results to any desired conversion level.

The same processing techniques were applied to a 50% Kuwait residue at an 80% desulfurization level. Results are shown in Table 3. Here a distillate yield of 4% gasoline and 15% furnace oil is obtained, and the 670° F. + residue contains 0.9% sulfur.

The furnace-oil-free product from the HDS processing of atmospheric residues may be used in various ways. In foreign refineries, the use will generally be as a high-grade heavy fuel oil. In a number of foreign locations the premium associated with residual fuel oils of about 1.5% or less sulfur is $0.50-$0.70 per barrel.

This sulfur level is readily attained by using HDS even when processing Kuwait crude, which has a high sulfur level. With lower-sulfur-content crudes, the 1.5% sulfur level can be reached still more easily with HDS. Under conditions such as exist in these foreign locations, desulfurization of residues by HDS becomes a very attractive venture.

It is also likely that high-quality heavy fuel oils, such as are produced by HDS processing either vacuum or atmospheric residues, will find domestic application. In many locations, political and social pressures are forcing the use of low-sulfur fuels.

It is also apparent that large savings could be realized by many consumers using slow-speed diesel engines or gas turbines or operating direct-fired kilns if high-priced distillate fuel oil could be replaced by a less-expensive residual fuel not having the sulfur or metal contamination levels usually associated with heavy oils. Some effort is being made by the railroads,[2] for example, to reduce fuel costs by burning some residual fuel. In addition, with the proper control of specifications it is possible to use residual oils in gas turbines.[0] Thus, it seems reasonable that markets are available for a fuel oil intermediate in price and quality between normal residual fuel oil and diesel or furnace oils.

Considering only the present-day situation, however, the dominant use for an HDS-processed atmospheric residue in this country will be as a source of upgraded virgin gas oil and residue. Such a use for a 50% residue processed to an 80% desulfurization level is shown in Table 4.

It is apparent that the heavy-gas-oil portion of this residue has been upgraded, and the quantity of distillates significantly increased. Quality improvement in the heavy-gas-oil fraction is shown by the reductions in sulfur from 3.1 to 0.6%, in carbon residue from 0.9 to 0.1%, and by the increase in characterization factor from 11.72 to 11.92. Improvement in carbon residue and metals would permit deeper vacuum distillation of the residue, thereby increasing the yield of heavy gas oil.

From these results it is apparent that HDS-processing of atmospheric residues is of interest to both domestic and foreign refiners, although the use of the products by the two may differ considerably.

TABLE 3—MILD HDS-PROCESSING OF AN ATMOSPHERIC RESIDUE

Desulfurization: 80%
Product Yields:

Vol. % of charge	Charge	Products
Gasoline (C_4-400° F.)	Kuwait	4
Furnace oil (400°-670° F.)	atmospheric	15
Residual oil (670° F.+)	residue (50% by vol. of crude)	83
Product Inspections		
Gasoline		
°API		49.9
% Sulfur		0.05
% Aromatics		22
% Naphthenes		18
Furnace Oil		
°API		31.4
% Sulfur		0.05
Aniline point: °F.		130
Diesel index		40.8
Residual Oil		
°API	15.3	20.9
% Sulfur	3.9	0.9
Viscosity, S.U.s.		
at 100° F.	5,640	1,100
at 210 °F.	180	78
Vanadium: p.p.m.	40	3.4

TABLE 4—MILD HDS-PROCESSING OF AN ATMOSPHERIC RESIDUE

Desulfurization: 80%
Product Yields:

Vol. % of charge	Charge	Products
Gasoline (C_4-400° F.)		4
Furnace oil (400°-670° F.)		15
Heavy gas oil (670°-1,000° F.)	64	60
Residue (1,000° F.+)	36	23
Product Inspections		
Gasoline		
°API	Kuwait	49.9
% Sulfur	atmospheric	0.05
% Aromatics	residue	22
% Naphthenes	(50% by vol. of crude)	18
Furnace Oil		
°API		31.4
% Sulfur		0.05
Aniline point: °F.		130
Diesel index		40.8
Heavy Gas Oil		
°API	21.4	24.7
% Sulfur	3.1	0.6
% Nitrogen	0.14	0.12
% Carbon residue (Conradson)	0.9	0.1
Vanadium: p.p.m.	0.4	<0.1
Nickel: p.p.m.	0.2	0.1
Characterization factor	11.72	11.92
Residue (1,000° F.+)		
°API	5.5	11.5
% Sulfur	5.5	1.4
Vanadium: p.p.m.	102	12
Viscosity, S.U.s.		
at 100° F.	.....	31,300
at 130° F.	.....	1,450
at 210° F.	22,130	.....
Cutter-oil requirement: % by vol. of 1,000° F. straightrun residue	51	16

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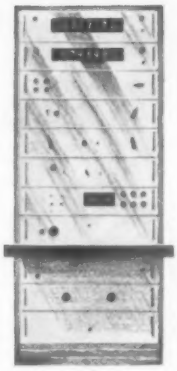

COMPUTER CONTROL OF CATALYTIC REFORMING PROCESSES

- Today computer control is an economic advantage. Tomorrow it may be a necessity. Keeping economics uppermost in mind, here's

- A quick look at the reforming process in general.
- Why the computer is first installed as a data-logging machine and how it evolves into a supervisory optimizing-control system.
- Why and how the computer can save the refiner money by increasing process knowledge for operations guides, closer operation, better scheduling of shutdowns, and better use of product in the over-all refinery scheme.

Fixed-bed catalytic reformers will be treated generally. No attempt has been made to single out a particular process.

BY REUBEN SILVER

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CATALYTIC REFORMING processes are generally characterized as being continuous, high-temperature, high-pressure processes carried out in a hydrogen atmosphere. Reaction temperatures are around 750° to 1,000° F. Reaction pressures range from 100 to 750 psi. Hydrogen recycle ratios of 3 to 12 moles per mole feed are used. Charge stocks are usually straightrun naphthas. Some operators also charge a certain quantity of straightrun gasoline. Many operators charge mixed straightrun and hydrogen-processed cracked naphthas.

Fixed-bed catalytic reforming uses series-connected reactors through which the oil-and-hydrogen charge stream is passed after preheating to reaction temperature. Since the net reaction is endothermic, an approach to isothermal conditions is maintained by interheating. Reactor effluent is cooled and phase-separated. Separator vapor, mainly hydrogen, is compressed and returned to the process. The liquid, after stabilization, is the product.

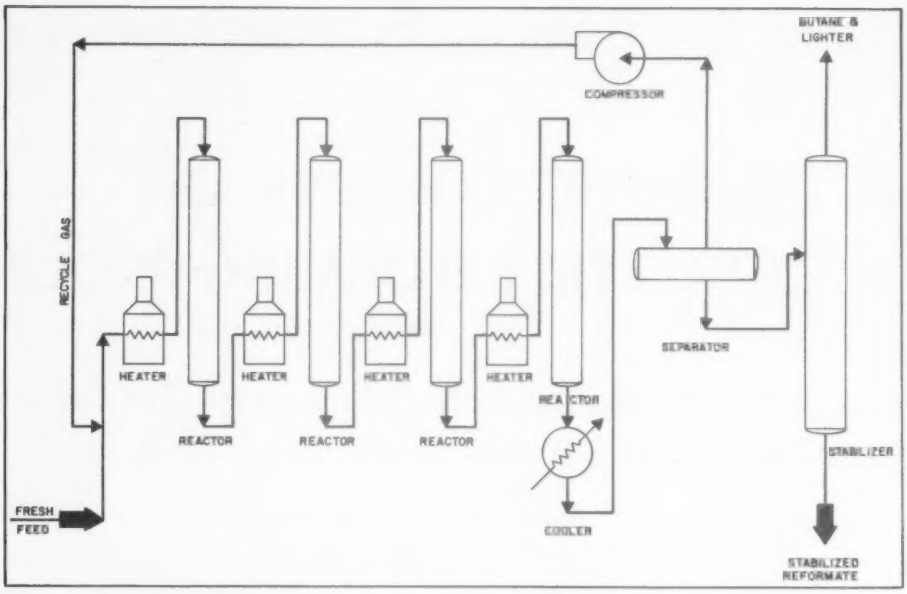
Variations exist even for a single specific process. For instance. liquid from the separator might be charged at a reduced pressure to a flash-vaporization stage to remove much of the lighter components before going to the stabilizer. Sometimes the reformate is separated into light and heavy cuts by fractionation. If cracked naphthas are charged to the reformer, it is usually necessary first to remove reformer-catalyst poisons.

Reforming Catalysts

Several catalyst types are in general use. For fixed-bed processes, expensive platinum-containing catalysts predominate. These catalysts are usually in the form of pellets or tablets of less than ¼-in. diameter. The platinum content, usually less than 1%, exists in a reduced state in active catalyst. Alumina or silica-alumina supports are used.

For a reactor train consisting of three reactors, a typical catalyst distribution is 15% of the catalyst in the first reactor, 30 % in the second, and 55% in the third. These figures are set by research and experience and the equipment is usually designed to comply.

Due to high catalyst value, catalyst life is an important consideration. Catalyst life (activity) is subject to permanent reduction by several con-



TYPICAL FIXED-BED catalytic reforming process using series-connected reactors. Fig. 1.

taminants. Coppers, lead, arsenic, selenium, and some alkali-metal compounds are common platinum catalyst poisons. In some cases, 10 p.p.b. of the poison in the charge stock can cause serious shortening of catalyst life.

Arsenic, for example, seldom occurs in straightrun naphthas. Many cracked naphthas contain up to 200 p.p.b. of arsenic.

Sulfur and nitrogen depress the activity of many catalysts. Nitrogen is not generally a permanent poison and can be worked out of the system providing it is excluded from the charge. Nitrogen depresses the "acid function" of the platinum catalyst; this function is responsible for the important cyclization and isomerization reactions.

Provided that no damage by the permanent catalyst poisons has occurred, most catalysts can be regenerated. This involves burning off accumulated carbon from the catalyst. With some catalysts, this can be done in place, restoring the initial catalyst activity. In other cases the catalyst must be removed and regenerated separately. The injection of small amounts of chemicals into the process stream is sometimes done to inhibit the action of poisons on the catalyst.

Process Reactions

Each hydrocarbon in the charge stock which reacts at reformer conditions undergoes chemical reactions peculiar to that hydrocarbon.

Hydrocarbons in the charge, however, can be grouped into paraffins, olefins, naphthenes, and aromatics. In the reformer the members of each of these groups undergo reactions typical of the group. This allows simplifying generalizations in analyzing these reactions, which suffice in a majority of practical cases.

The reactions known to occur during catalytic reforming include the following:

1. Dehydrogenation and dehydroisomerization of naphthenes.
2. Dehydrocyclization of paraffins.
3. Hydrocracking of paraffins.
4. Isomerization of paraffins.
5. Saturation of olefins.
6. Release of sulfur from organic compounds.
7. Formation of polymers.
8. Deposition of carbon on the catalyst.
9. Reverse reactions of 1 through 6 above.

The principal octane improvement is accomplished by the aromatization reactions listed in the first two items. The next four items generally contribute toward octane improvement in the final product. The last three reactions are detrimental to the process.

Formation of aromatics by dehydrogenation of six-membered-ring naphthenes and dehydroisomerization of five-membered-ring naphthenes takes place rapidly at reforming conditions. This fact represents the principal value of the reforming process. Though these reactions result in volumetric shrinkage, both octane number and volumetric heat of combustion are improved. These reactions are endothermic.

Dehydrocyclization of straight-chain paraffins having six or more carbon atoms also results in aromatization. In this way, some charge components may be increased by as much as 100 octane numbers. This reaction also results in a volumetric shrinkage and is endothermic.

Since reforming naphtha charge stocks generally contain high-boiling paraffinic components, hydrocracking can be useful. Long-chain paraffins are broken into shorter chains by carbon-to-carbon cleavage. Excess hydrogen in the reaction prevents the formation of olefins to any significant extent. Besides decreasing the product-component boiling points, hydrocracking offsets some of the volumetric shrinkage resulting from aromatization reactions. Hydrocracking reactions are exothermic.

Paraffin isomerization is an important reaction in the over-all process. Naphtha charge stocks are largely paraffinic but reaction rates allow but a small portion to be converted to aromatics. Significant amounts of naphtha fractions remain with octanes as low as 10. Isomerization reactions can result in increases of 40 or 50 octane numbers. This materially helps the over-all yield of 100-octane product.

Straightrun naphthas and gasolines contain small amounts of olefins. Cracked naphthas are high in olefins and frequently are charged together

"Reactor temperature is probably the most important variable in cat reformer control."

with virgin stocks to the reformer. Some of the excess hydrogen released by the aromatization reactions saturates olefins present in the charge and prevents formation of more olefins during reforming. Saturated paraffins have lower octane ratings than the original olefins but lead susceptibility is generally increased by saturation.

Cracked naphthas frequently contain significant amounts of substances poisonous to reformer catalysts. For this reason many operators preprocess such stocks in a hydrogen-processing unit, using excess hydrogen from the reformer. Catalyst poisons are removed, olefins are saturated, and a naphtha similar to a virgin naphtha results.

Essentially, all of the sulfur existing as organic sulfur compounds in the charge is converted to hydrogen sulfide in the reformer. The product reformate benefits, since sulfur reduces lead susceptibility.

Hydrogen sulfide depresses the activity of most reformer catalysts. Frequently, removal of hydrogen sulfide from the recycle gas is economically feasible to improve catalyst activity. In other cases, and especially when cracked naphthas containing the metallic catalyst poisons are charged, sulfur and poisons are removed upstream of the reformer.

The formation of highly aromatic polymers and deposition of carbon on the catalyst are detrimental to the process. The former decreases the yield of desirable aromatics. The latter is the result of deep cracking, and coats the catalyst, reducing its activity. Deep cracking is accompanied by the production of light hydrocarbons which further reduces the product yield. Since the rates of the octane-improving reactions are generally many times greater than the rates of the reverse reactions, the latter cause no trouble.

Process Variables

Process variables in fixed-bed reactors are:

1. Reactor temperature.
2. Reactor pressure.
3. Reactor space velocity.
4. Hydrogen-to-hydrocarbon mole ratio.
5. Charge-stock composition.
6. Catalyst activity.

All of these variables affect the product quality and the economics of operation.

The first three of these variables, listed in order of the effect on product quality, are usually under the direct control of the unit operator, as far as is possible for the particular unit and type of operation.

The fourth may be controlled by the operator in some cases. It is frequently fixed during the design of the plant on the basis of a known charge stock and severity of operation, or is fixed during plant operation by other considerations as discussed later.

The fifth variable, charge-stock composition, is normally not at the discretion of the operator. This is true especially when the charge stock is a single stream from an upstream unit. If streams from multiple sources are charged, the operator has some range of control over the final charge-stock composition.

Catalyst activity, the last variable, depends upon the catalyst age and the previous catalyst history.

Severity is a combination of temperature, pressure, and space velocity. Higher severity results in higher-octane product, but may also be accompanied by reduced product yields. Higher severity is accomplished by one or more of the following:

1. Increasing reactor temperature.
2. Decreasing reactor pressure.
3. Decreasing reactor space velocity.

Control Considerations

As in all processes, control of reformers for desired results is achieved by control of the process variables. Reactor temperature is probably the most important variable in the control of the catalytic reformer. In a particular unit, pressure and space velocity are usually fixed by basic operational considerations as discussed later. This leaves temperature as the controlling factor in severity control. Reactor temperature is controlled at the reactor inlet (furnace outlet).

Temperature. All reactions taking place in the reformer reactor accelerate with increased temperature. Aromatization reactions reach a high level at relatively low temperatures, before the rates of other reactions become comparatively significant. At higher temperatures, hydrocracking and dehydrocyclization reactions begin to accelerate.

Generally, reactor temperature should be controlled so that essentially complete aromatization is accomplished, with enough hydrocracking to result in the required yield, octane number, and product end boiling point.

In the typical reformer, aromatization of naphthenes is about 50% complete in the first reactor and virtually complete in the last. Dehydrocyclization and hydrocracking are small in the first reactor and more rapid in the others. For control purposes, the extent of aromatization can be estimated by the temperature drop across the reactors, especially the No. 1 reactor.

The per cent of aromatics in the product, and the amount and hydrogen content of the separator gas, are also used for process control. As a general rule, an increase of 4° to 6° on all reactor inlet temperatures results in increasing the reformate F-1 clear octane by one.

The question can be raised here as to operating the reactors at individually different temperatures. Because different reactions occur at different rates in each reactor, closer individual temperature control is undoubtedly advantageous. Since this question is closely related to catalyst life and charge-stock composition, a definite answer must await analysis of the particular reformer.

At high reactor temperatures, the danger of overcracking exists. Overcracking may be evidenced by a yellow-colored product. Severe hydrocracking is also indicated by reduced liquid-reformate yield, increased gaseous product, and decreased hydrogen content of the gas. Since the net reforming reaction is endothermic while the cracking reactions are exothermic, severe hydrocracking may be accompanied by a decreased temperature drop across the last reactor.

Minimum reactor temperature with a new and active catalyst is governed by the desired yield-octane relationship.

Maximum reactor temperature with an old catalyst may be governed by the same factors or may be limited by the extent of hydrocracking developed in the process, and deposition rate of carbon on the catalyst. In a large number of cases, maximum temperature is limited to the 975°-990° F. range by the furnaces.

Pressure. Reactor pressure, reactor space velocity, and hydrogen-to-hydrocarbon mole ratio are largely interdependent variables. All are dependent upon the type of operation

of the unit. By type of operation is meant whether the unit is operated for peak aromatic production or for avgas and motor-fuel production.

A large number of fixed-bed catalytic reformers operate at 500 psi. reactor pressure for gasoline production. Similar units for peak aromatic production might operate at 300 to 400 psi. In some cases, particularly where 100-130-octane avgas is desired, the unit may be operated as for peak aromatic production.

As might be expected from the presence of excess hydrogen in the reaction, increased pressure results in decreased aromatization. Since increased pressure increases hydrogen recycle rate, it also decreases the tendency for coke to form on the catalyst. Increased pressure also favors hydrocracking.

Pressures for the entire system are governed by the first-stage separator pressure. Separator pressure is generally controlled at a point fixed by the gas recycle ratio desired, since this pressure fixes the intake pressure of the recycle-gas compressors.

The higher the compressor-intake pressure, the greater the amount of hydrogen returned to the process; hence the higher the hydrogen-to-hydrocarbon mole ratio. Hydrogen recycle ratios above certain values do not enhance the process and tend to decrease space velocity (or charge rate) in a given unit.

As a general rule, reactor pressures are controlled at the maximum which is compatible with aromatization reactions and with equipment design. Reactor pressures should not be lower than those specified for the unit and for the type of operation. For high-octane-gasoline production, typical pressures may be in the following ranges:

1. 600-650 psi. charge-pump discharge.
2. 525 psi. inlet first reactor.
3. 500 psi. outlet last reactor.
4. 470 psi. first-stage separator.
5. 250 psi. second-stage separator.
6. 130-160 psi. stabilizer.

If only one separator stage is used, pressures upstream are not affected for similar types of operation, while the stabilizer may operate at higher pressure with increased liquid overhead product. Sometimes, with either one or two separators, the stabilizer is operated at such pressure that no net liquid overhead product is made. Gaseous overhead product goes to vapor recovery.

Space velocity. Reactor space velocity is controlled normally by the charge rate, which is one of the first factors decided in the design of the plant. Typically, fixed-bed reformers are designed for 1.5 to 3.0 liquid-weight-hourly space rate for a specific catalyst loading.

These figures are based on the fresh-liquid-hydrocarbon charge only and the total catalyst weight, and show that for each pound of catalyst, from 1.5 to 3.0 lbs. of hydrocarbon per hour is put through the unit. This allows a twofold range in charge rate, which is the usual maximum range economically advisable for fixed-bed reformers.

Within limits, catalyst loading can be increased or decreased, which shifts the level of this twofold range respectively higher or lower.

Charge rates much greater than design result in less octane improvement and may cause the reformate to fail the boiling-point specification. Charge rates too low favor catalyst coking. Because of high rates of reaction for aromatization and the low rates of reverse reactions, variations in charge rates do not affect aromatization greatly. Hydrocracking, howver, is greatly affected, and care should be taken in making charge-rate changes.

Provided the changes made in charge-rate are within space-velocity limitations for the particular unit, these changes can be offset by reactor-temperature adjustments. When charge-rate is reduced, a prior reduction in reactor temperature should be made. Likewise, if a charge-rate increase is made, it should be done before the temperature is increased. This minimizes the possibility of severe hydrocracking with attendant rapid coking of the catalyst.

If reformer charge stock is in short supply for any reason, some operators dilute the normal charge with light gasoline hydrocarbons to maintain space velocity.

Mole ratio. Normally, the hydrogen-to-hydrocarbon mole ratio is set to provide only a small excess of hydrogen above that required to suppress coking of the catalyst. For gasoline production using naphtha charge stocks, at least eight moles of hydrogen per mole of fresh hydrocarbon charge is required for coke suppression. For peak aromatic production, ratios of six or seven to one are frequently tolerated. Ratios higher than eight to one do no harm except where they detract from the charge rate as equipment limitations are reached.

For the normal operating ranges of the hydrogen recycle rate, the effect of this variable on aromatization or hydrocracking reactions is generally not important. This variable is seldom if ever controlled for octane or yield improvement.

Actually, from one viewpoiont, hydrogen recycle rate tends to be self-limiting. If this rate is increased by an increase in separator pressure, the reactor pressure is increased. This in turn tends to suppress aromatization reactions and promote hydrocracking, which result in decreased hydrogen production. This partially offsets the effect of increased separator pressure. If temperature is increased, hydrocracking reactions increase, and these consume hydrogen.

One caution must be observed when increasing charge rates. Recycle gas rate must give an adequate hydrogen-to-hydrocarbon mole ratio for the new charge ratio. The reformer operator may directly vary the hydrogen-to-hydrocarbon ratio by changing the charge rate without changing the recycle-gas flow rate, by changing separator pressure, and by changing the r.p.m. of the compressors.

Charge stock. For peak aromatic or 100 to 130-octane avgas production, the charge stock may be a special naphthenic concentrate. For gasoline production, charge-stock composition is almost always that of a naphtha or a gasoline-naphtha mixture. A typical good reformer charge stock for gasoline production has the following properties:

1. Low sulfur, nitrogen, and metals content.
2. Low olefins content.
3. Initial boiling point 200° F.
4. End point 400° F.

Sulfur and nitrogen are reformer-catalyst-activity depressants, while several metals are permanent catalyst poisons. Catalysts differ widely in their sensitivities to these depressants and poisons. For protection of the catalyst and for top octane product, recommendations of the process licensor or of the catalyst manufacturer should be followed in charge-stock preparation. The most popular and successful charge-stock preparation is hydrogen processing. No general rules exist for poison or depressant-content limits in charge stocks.

Olefins are saturated under reformer process conditions. Since olefin saturation consumes hydrogen, a highly olefinic charge might make it impossible to maintain an adequate hydrogen-to-hydrocarbon ratio. Straightrun naphthas are low in olefins. Cracked naphthas are generally

"High-boiling components in cat reformer must be hydrocracked to meet specs."

rich in olefins. Typically, the reformer charged with considerable straight-run material produces hydrogen sufficiently in excess of process requirements to operate an adequate hydrogen-process unit for feed preparation.

Paraffinic charge-stock components boiling below 200° F. (some C_7 and C_6 and lighter) do not react to any great extent under reforming conditions; their octanes are fairly good anyway, and their octanes are not greatly improved. Inclusion in the charge does no harm and many operators charge near-full-cut naphtha mixtures with i.b.p.s of 150° F.

Should sufficient 200° F. i.b.p. be available to load the reformer, it is generally economically advisable to charge this in place of lighter material. On the other hand, if the crude is highly naphthenic, the fraction boiling between 150° and 200° F. contains considerable C_6 and C_7 naphthenes which are valuable aromatics formers and should not be excluded from the charge.

High-boiling components in the reformer charge require hydrocracking to meet the product boiling-point specification. Severe hydrocracking results in loss of liquid-product yield through production of gaseous hydrocarbons, and in rapid coke formation on the catalyst. A charge-stock maximum end point of 400° F. (C_{12} range) is specified by many reformer process licensors.

Those processes which are able economically to use heavier charge stocks generally have catalysts which can be regenerated rapidly and easily with minimal loss in catalyst activity. As a rule, charge stocks with end points above 430° F. are not used for reformate-gasoline production.

Catalyst activity. Unlike other process variables, catalyst activity is not subject to control for enhancement of the process. It is, however, an important process-control consideration since, in a large measure, it fixes control of the other variables. The high value of catalyst and the economic penalty of lost production during catalyst regeneration or replacement are influential factors in fixed-bed-reformer control.

Control Philosophies

At any given moment, the operator must base the control of his process upon the following basic considerations:

1. Catalyst activity.
2. Charge-stock composition.
3. Charge-stock quantity available.
4. Desired yield-octane relationship.

The first two of these were discussed as process variables. All other process variables are virtually fixed by the above four considerations, once the type of operation is selected. (Even type of operation is generally fixed by the above considerations, especially charge-stock composition, upon which the original plant design may also be based.)

For example, the type of operation normally fixes both the pressures throughout the unit and the hydrogen-to-hydrocarbon ratios; space velocity is limited by the plant design, catalyst loading, and by charge-stock availability. Reactor temperature remains as the chief means of control, and this is fixed by the four basic operational considerations.

The predominant control philosophy for high-octane motor-fuel production is based on an adequate and constant charge composition and quantity, and the process is controlled according to the catalyst activity-reactor temperature relationship.

The process operator with a newly replaced or regenerated catalyst may begin operation at, for example, 825°-850° F. reactor temperature and raises the temperature, say, 5° F. each week to offset the loss of catalyst activity until the 975°-990° F. limit is reached. Yield and octane take care of themselves.

The high value of platinum catalyst renders it economically advisable to extend the catalyst active life as long as possible. Moreover, lost production time is expensive, and the labor and materials for catalyst regeneration or replacement are additional and frequently major expenses. Other variables remain constant throughout, since catalyst life is generally believed to be longer when this is done.

Under this control philosophy, yield and octane are predictable to a sufficient degree with experience, so that the exact quantity and octane of the finished motor fuel are economically arrived at with additions of TEL, other additives, and blend stocks. Also, plant shutdowns for catalyst regeneration or replacement can be scheduled accurately.

Notable variations of this control philosophy are frequently practiced.

One such variation may be because of signing of a contract for 100-130-octane avgas. After gathering sufficient charge-stock of adequate composition, the operator raises reactor temperatures and/or lowers reactor pressures (increases process severity) to achieve the yield-octane relationship desired. When the avgas commitment is fulfilled, temperatures and pressures are returned to the scheduled levels to conserve catalyst activity.

Another variation is resorted to when the catalyst is nearing the necessity for regeneration or replacement. Since conserving catalyst activity is no longer a factor, process severity can be increased to the limits of the equipment. Temperature is increased to the limit and heavier charge stocks are sometimes used. Pressure is often lowered to increase hydrocracking. Finally, space velocity may be lowered. At this point, operation becomes uneconomical from the yield-octane standpoint.

Other control philosophies generally stem from peculiarities in overall refinery operation. In some cases varying yield and octane requirements are prime factors, even when charge-stock quantity and composition remain the same. Many operators are forced at least occasionally into short-range planning by the necessity of using in a final blend, both reformate and some components from other processes. Such components may vary both in quantities and qualities.

In these cases process severity and/or charge-stock composition are varied within the process and economic limits to produce a reformate of adequate quality for a specification blend. Some reformers operate with periodic changes in charge-stock quantity and/or composition.

In recent years, foreign crude production has grown faster than domestic. Many refineries now charge considerable foreign crude, and many do not charge the same crude for more than a few consecutive weeks. The consequent naphtha variations are often small and present no problem, since crudes with smilar properties are selected.

In a number of cases, however, enough naphtha variation exists to require control adjustments at the reformer for desired yield and octane. Here again, process severity is balanced against catalyst activity to achieve the required result.

Regardless of the particular control philosophy followed by the individual operator, he must end with a product having certain specifications. He is forced to do the best he can with what

he has. In the final analysis, the problem is one of economics.

Process Control Computers

Control computer applications are a normal evolutionary development in industry. When first applied, the continuous process was the largest single improvement over batch operation at the time.

The development of cascade-control instrumentation was the largest single factor in improving the economics of the continuous process; product uniformity, higher product quality, greatly increased yields, and lower personnel costs were all made possible in an increasingly competitive field.

Large-scale industrial innovations begin as economic advantages and rapidly become economic necessities. Optimizing computer control may be the next phase.

Computer types. System reliability and adequate process-sensing equipment have been developed to the point where the process-optimizing computer is economically attractive. Commercial optimizing-control computer applications now exist or are being planned throughout industry. Other good systems exist, but the largest developments have been in electronic computers.

Electronic computers are designed according to two philosophies: analog or digital. Each philosophy has its advantages, both inherently and for particular applications.

The electronic analog computer, as its name indicates, is an electronic analog (or model) of the system under study, whether it be a military missile, a power plant, or a chemical-process plant. Proposed system changes can easily be programed on the analog computer. The performance of the computer under the changes then predicts the performance of the system, with an accuracy limited by the extent to which the computer is an accurate model of the system and the accuracy of the components. The slide rule is a simple analog computer, it being the analog of a table of logarithms.

The digital computer operates by arithmetic addition of discrete data. If the speed of the individual group of digits is sufficiently high, any mathematical relationship can be solved in a given time by addition. Differential equations are solved by integration and, since the solution by integration is a summation of differential increments, this can be done by both analog and digital computers. The abacus is the most primitive digital-computing machine. This article deals mainly with application of the digital computer because its forte is the complex system-control problem.

Mode of operation. In general, optimizing-digital-control computers function according to one of three modes: predetermined, explorative, and adaptive.

The predetermined mode presupposes knowledge of the mathematical relationships among the process variables and the economics of the process to the extent that accurate curves of the significant relationships can be drawn. The equations of these curves are built or programed into the computer. Given the values of variables fixed by other considerations, the computer then controls the remaining variables to give the maximum profit for the process. An exact mathematical model of even a moderately complex chemical process is at best difficult to achieve. Even the personalities of individual items of equipment with respect to the process in a given plant enter the problem.

The explorative mode presupposes no previous process knowledge. Given control of the controllable process variables, the computer changes these variables one at a time and notes the results in the process profit. Each change which results in increased profit is followed by a change in the same direction until profit begins to decline. This mode of operation has been termed surface searching.

The adaptive mode is increasingly interesting of late. It can be said to be a combination of the predetermined and explorative modes. The adaptive mode recognizes and uses all previous process knowledge and learns from the process, by means of statistical or planned upsets and changes, how to increase profits. In a way, both the explorative and the adaptive computers build with the process variables, mathematical multidimensional surfaces. Changes in process variables in the direction of maximum slope are in the direction of maximum profit increase.

At this stage of development, none of the three computer modes is simple in design. Almost no process is known so well that it can be mathematically described easily with any degree of completeness, disregarding economics. The necessary inclusion of process economics into the problem on the one hand adds simplifying limitations and on the other adds many complex relationships.

Computer Application

Fortunately, application of the control computer to the process can be handled by an evolutionary approach. One such program for predetermined and adaptive computers consists of these four phases:

1. Open-loop study.
2. Closed-loop supervisory operation.
3. Supervisory optimizing control.
4. Complete supervisory optimizing control.

Open-Loop Study. For a catalytic reformer, the first phase consists of a detailed study of the effects of the process variables, especially severity, on the reformate yield and octane and on catalyst-activity attrition. Many useful data are generally available from process records such as strip charts, operator log sheets, etc. Reduction of these data to usable form can frequently be done best by a computer.

Should no data or data of doubtful value exist, the installation of a logger or a computer-logger capable of being expanded for optimizing process control can be practical. In this case, the effects of process variables on yield, octane, and process costs are determined by controlled changes in reformer operation.

Most operators of existing reformers will have followed process-licensor recommendations about pressure and gas-recycle-rate variables, or will have determined for themselves the best operating levels of these variables, for their own charge-stock compositions. Charge rate (space velocity) and temperature remain as the controllable variables. Yield and octane are dependent variables from the process standpoint.

For analysis, the temperature-catalyst activity relationship may be termed process severity. Since severity and octane bear an almost linear relationship, a family of curves is drawn relating severity - octane to yield and charge rate. A similar set of curves is drawn for butanes produced, since they are important byproducts.

While the process study progresses, an analysis is made of process instrumentation. The control system consisting of the control computer and the conventional instrumentation is no better than the data input to the computer. It is obviously a handicap to install a control computer if sensing and control equipment for the important flows, temperatures, and pressures is lacking.

For the maximum advantage of

"Programing is ever a significant portion of total effort in a computer application."

computer control over control by conventional instruments, stream analyzers must be added. This is because fundamental control variables are considered by stream analyzers instead of secondary parameters. Many operators are already familiar with stream analyzers, having installed them as control aids or direct-control instruments. Unfortunately, no instrument for in-line octane analysis has been accepted by industry.

For this first phase of control-computer application, several months' effort on the part of both the refiner and the computer-system designer is required. In addition to "open-loop study," computer application to this phase of the program is also termed "off-line control."

Closed-Loop operation. Once adequate control instrumentation and stream analyzers have been installed and are operating, it is possible to tie the computer into the system. The computer is already roughly programed for the job. All process data from the flow, temperature, and pressure-measuring devices which the human operator would consult for control of the unit are inputs to the computer. All control instruments having set points and which are required to control the process are connected to the computer outputs.

The problem of "common language" arises here. The majority of flow and pressure instruments interpret data in terms of a pneumatic-pressure signal. Temperature instruments are either pneumatic pressure or low-level voltage. Some stream-analyzer outputs are electric currents. All are analog signals and cannot be utilized as such by the computer.

All must be translated by transducers to a common language such as an analog voltage which can be digitized and understood by the computer. Likewise, computer output signals for control must be translated from "computer language" to whatever is required to adjust the set point of a conventional instrument.

When all connections have been made to the computer inputs and outputs, the computer is in control of the process; the loop has been closed.

The computer is now preforming the functions of the human operator in adjusting set points of conventional controllers for desired operation. It has not replaced the human operator, who can at any time override the computer or change the stored program in the computer on the basis of a new knowledge of the process. The human operator is needed for plant startup. In addition, emergencies may arise which the computer is not equipped to handle, such as fire. The computer is programed to handle some emergencies, such as charge flow or recycle-gas failure. The first period of closed-loop control will consist of refinements of the computer program for closer adjustment to the process.

Optimizing control. A large portion of economic data necessary for the third phase—optimizing control for maximum profit—will have been gathered in conjunction with the work done in the first two phases. Since this phase differs only in the complexity of the computer program from the first two phases, it can follow as soon as the computer has sufficiently accurate control of the process. Of course, optimizing control is continually expanded and refined as knowledge of the process and of the controlled equipment increases.

For instance, as time lags from equipment item to equipment item in the unit are known with increasing accuracy under various operating conditions, the computer is programed to anticipate and offset the effect of uncontrolled variations in process variables. Then again, more instruments may be tied in and major changes in economic conditions may change operation.

Complete supervisory optimizing control can be carried to the ultimate in sophistication for supervisory control. In this phase the computer not only controls the process for maximum profit but also senses the flows, temperatures, and pressures around every major item of equipment in the plant.

The computer is able on demand to furnish heat and material balances around the individual equipment or around the whole plant. The operator can then know the condition of any equipment item in the plant at all times.

For an adequately designed computer this capacity represents little additional investment in the computer hardware. It does represent more investment in data-gathering instrumentation and in additional programing.

A supervisory-control computer performs the function of the human operator in adjusting the set points of control instruments. This is in contrast to "complete control," in which conventional controllers are replaced by the computer. With supervisory control, the process continues to operate at the most recent set points on the controllers, if the computer is taken out of service for any reason.

The computer must measure process performance. It then compares this with the desired performance according to the process constraints and the optimizing equations. On the basis of the comparison, the computer-directed system adjusts the conventional controller set points to bring the process back to the desired condition.

The ultimate objective of the operator is accomplished, namely, getting the most out of his unit, despite changes in uncontrollable variables. In other words, the computer is superimposed on the process to maximize the profit.

Design factors. The designer of the computer system is concerned with the following factors in applying the optimizing-control computer to any process:

1. Computation speed.
2. Accuracy.
3. Reliability.
4. Memory capacity.
5. Ease of programing.
6. Expansibility.

The computer selected for optimizing the cat reformer should be fast enough to generate control signals that will neutralize the effects of process disturbances before they have affected yield and octane. Internal-information access time is important here.

Accuracy of the computer should be such that it matches the accuracy of data-acquisition devices and has some spare significane to accommodate accuracy loss through the use of numerical-approximating techniques on the computer.

In mechanizing the catalytic reformer operation decisions, the computer is constantly solving a set of logical equations to determine the best reponse to be made for any uncontrollable change in the process. The equations have many nonlinearities and crosscouplings in the interacting control loops. The data-processing power of the computer should be such that these nonlinearities do not have to be bypassed.

Business or scientific computers can be easily maintained between peri-

ods of operation. The total life of a military computer may be in the range of ½ hour to 1,000 hours. One thousand hours is less than 1½ months in the life of a process-control computer. Process-control computers must be reliable. Reliability can be expressed as a percentage according to the equation

(Total time minus down time) 100/
Total time = % reliability

The development of solid-state electronic devices and modular printed-circuitry techniques has considerably advanced electronic-system reliability. Process-control-computer reliabilities of more than 99% have already been reported for extended periods of operation.

Required memory capacity is a function of the computational techniques used and the number and type of separate computations to be performed. It will vary depending on the type of memory (random or cyclic), word length, required accuracy, and other factors controlled by the computer designed.

Programing is inevitably a significant portion of the total effort spent in a process-control-computer application. By far the major portion of the program need not ever be changed. Minor changes in program will be required after installation for refinement of control.

Once the economic advantages of applying the optimizing-control computer to a downstream unit such as the catalytic reformer are realized, the refiner will recognize that optimizing the process alone is not the whole story. Maximum over-all refinery profit is not gained until optimization of the finished-gasoline-blending operation is also included. Expansion of the computer itself may be required.

For supervisory optimizing control of the fixed-bed catalytic-reformer process, a computer capacity of 160,000 to 200,000 bits is required. A word length of 19 to 23 bits, including sign, is adequate. An input-scanning rate of 10 per second and a controller set-point adjustment interval of 2 to 5 minutes is necessary. Emergency instructions, if required, are issued each scanning cycle (about 10 seconds, depending on the number of inputs).

For a standard general-purpose digital computer, about 80% of the computer capacity is used for the stored program, on-line computations, and control. The remainder is available to actuate automatic logging equipment, to actuate on-demand or automatic visual readout equipment, for performing off-line computations, and for expansion of control.

Accuracy of the computer-directed control system depends solely on the accuracies of the conventional sensing and control equipment; the accuracy of the computer system itself is such that it adds no error to the over-all problem solution.

With an analytic-control computer made up of a hybrid general purpose-special purpose memory, about 20% of the memory is used for on-line control and 80% is available for off-line. Parts of the problem are more efficiently handled on the special-purpose memory and other portions lend themselves better to the general-purpose section. Hence, it is generally possible to realize an over-all memory savings.

Figs. 2 through 9 represent the typical control loops for a fixed-bed catalytic reformer, showing the computer input and output points in the process for optimizing control. The diagrams show a reformer with four reactors and two separator stages.

The assumption is first made that this is an existing plant to which a supervisory control computer is added. Conventional instrumentation is used for direct control and a near-minimum of additional stream analyzers, not in use on most reformers, is added. Also assume that the alarm system is adequate and need not be handled by the computer. For a control system of minimum sophistication (less than that required for optimization), a total of 38 computer inputs and 13 computer outputs will replace all except 6 of the functions of the human operator in control adjustments. (More inputs as shown on the eight control-loop sketches are required for optimizing control.)

For 38 inputs, the computer is connected with the following:

	Computer Inputs	Computer Outputs
1. FRC on cracked naphtha	1	1
2. FR on SR gasoline	1	..
3. FR on SR naphtha	1	..
4. FRC on total reformer charge	1	1
5. Sp. gr. recorder on reformer charge	1	..
6. TRC's on furnace outlets	4	4
7. TI's on reactor inlets	4	..
8. TI's on reactor outlets	4	..
9. PI at feed preheat exchangers	1	..
10. PIC on reactor effluent return stabilizer reboiler	1	1
11. FR on refinery fuel gas at separator	1	..
12. Sp. gr. analyzer on separator vapor	1	..
13. PRCs on separators	2	2
14. FR on gas to vapor recovery	1	..
15. Stream analyzer on separator vapor	1	..
16. Stream analyzer on stabilizer O. H. vapor	1	..
17. Stream analyzer on stabilizer O. H. liquid	1	..
18. Stream analyzer on stabilized reformate	1	..
19. FR's on stabilizer O. H. liquid and vapor products	2	..
20. FR on stabilized reformate	1	..
21. FRC on stabilizer reflux	1	1
22. PRC on stabilizer O. H. accumulator	1	1
23. TRC on stabilizer reboiler	1	1
24. TI on stabilizer top vapor	1	..
25. PI's at stabilizer top and bottom	2	..
26. FRC on recycle gas	1	1

The six functions remaining to the human operators are:

1. Adjusting the five hydrocarbon liquid levels in the plant at the charge tank, the two separators, the stabilizer overhead accumulator, and the stabilizer bottoms surge volume.

2. Keeping water levels in the two separators within safe margins. This is usually required if water solutions of catalyst-conditioning chemicals are injected into the process stream.

3. Adjusting cooling-water flow to exchangers and propeller pitch at the fin-fan units to control the temperatures of reactor effluent to the first-stage separator and the stabilizer reflux.

4. Controlling chemical-injection quantities as required by the process or as recommended by the process licensor.

5. Monitoring pressure differentials across the furnaces and reactors.

6. Adjusting compressor operation as required.

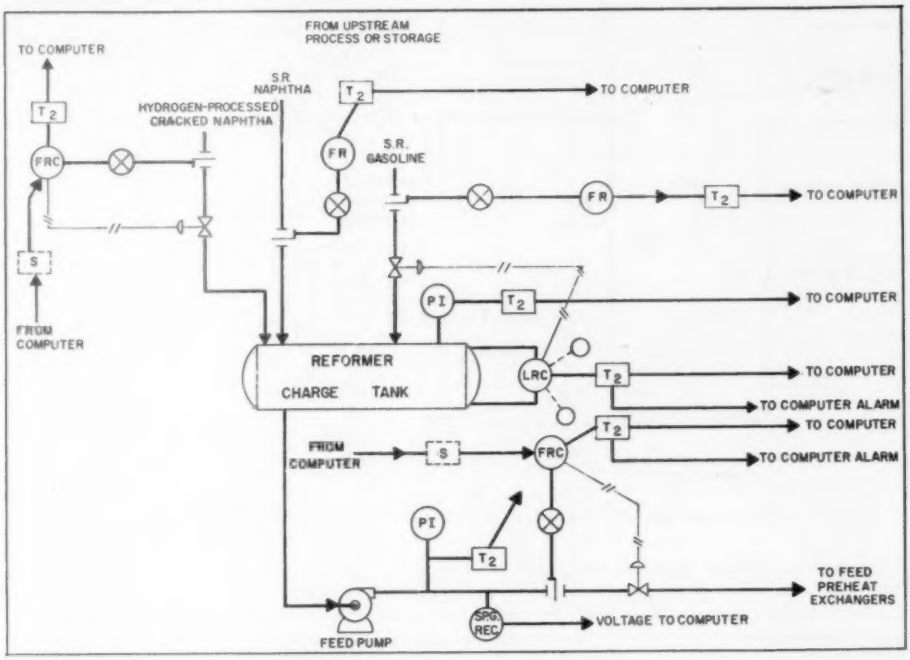
This control scheme does not permit the ultimate in optimizing control since insufficient process data are fed to the computer. All control instrumentation except level controls are adjusted by the computer.

Present-day level controls are among the most reliable instruments available. For this reason it is not recommended that level-control adjustments be made by the computer at least until the phase of complete supervisory control is reached.

Water from the two separators can easily be drained automatically by placing an interface-level-operated valve in the water-drain line, set to dump water and close. A restriction orifice in the water-drain line and an alarm to alert the operator if the drain valve fails to close are advisable.

This is made a function of the control computer by installing a solenoid-operated valve in the drain line under complete control of the computer, based on information from the interface-level indicator.

Automatic control of cooling-water



CHARGE-TANK CONTROL LOOP. Three-stream charge is straightrun naphtha, hydrogen-treated cracked naphtha, and straightrun gasoline. Fig. 2.

flow to heat exchangers to control the temperature of the cooled stream is not new. Many refiners have done this in the past and discarded it on the basis that hand operation is more economical. For the ultimate in computer-optimizing control, TIC's would be installed on the water-cooled exchangers for the reactor effluent and the stabilizer overhead. Likewise, TIC's would be installed for propeller-pitch control of the fin-fan units.

Flow recorders would be installed to meter water flow and watt meters to monitor the electric current to propeller-drive motors.

The optimizing-control computer would decide for each changing condition the most economical balance between electric power and cooling water. This arrangement represents a large investment in additional instrumentation and may not be economically justified in many reformers.

Of course, intermediate schemes are possible, such as automation of either the cooling-water control or the propeller pitch, with manual control of the other. The decision on how far to go with automation must await study of individual plant economics.

Chemical injection into the reformer charge stream is frequently accomplished with proportioning pumps on r.p.m. or piston-stroke control for flow metering. The process licensor's recommendation should be followed here. In any case, flow adjustments can be made by the computer on the basis of other process inputs to the computer, with sufficient information on chemical requirements. Here again, computer control may not be justifiable economically.

Sudden changes in pressure differentials can be indications of furnace-tube leakage or tube plugging, though these are seldom. An increased pressure differential across a reactor, if not caused by an increased charge rate, may be due to serious catalyst coking. In this case decreased catalyst activity would also be evidenced by decreased reformate octane. Pressure differentials across furnaces and reactors can, in many cases, help in predicting and scheduling reformer shutdowns for maintenance. Computer scanning of these for permanent logging or alarm is had by adding nine computer inputs.

The adjustment of compressor operation as required for control is reserved for discussion later with Fig. 8.

Control Loops

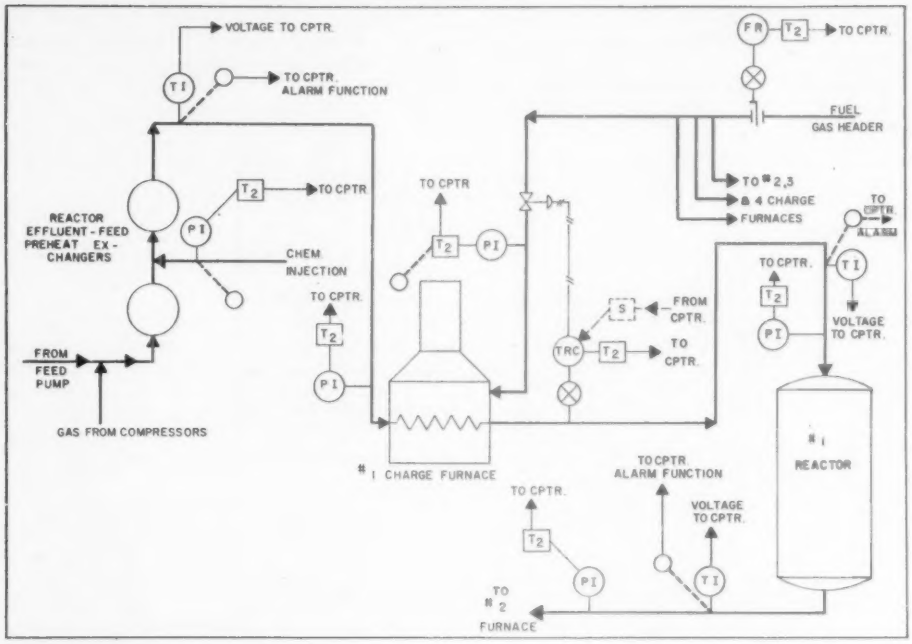
With few exceptions, conventional instrumentation symbols are used in the eight control-loop sketches. The symbol T_2 indicates a transducer which converts a pressure to an analog voltage signal. The symbol S indicates a transducer which converts an analog voltage to whatever is necessary to readjust the set point of the conventional controller. A total of 64 process inputs and 13 process outputs are shown.

Also required for optimizing control, but not shown as computer inputs, are the cooling-water flow rate, the rate of usage of electricity if the pumps and compressors are electrically driven, a gas flow rate if the compressor is gas-driven from a separate gas supply, and an instrument-air-supply pressure to alert the computer if air supply fails.

Note that there has been no increase in the number of computer outputs over the minimal system described earlier. Of course, in addition to process inputs, several manual inputs to the computer are required. For instance, a meter factor must be manually set into the computer for each orifice flowmeter, along with the unit values of each product stream leaving the reformer and each charge stream or utility entering the reformer.

Charge Tank. Fig. 2 is the charge-tank control loop. A three-stream charge consisting of straightrun naphtha, hydrogen-processed cracked naphtha, and straightrun gasoline is shown. As is the case with a majority of reformers, the straightrun naphtha is the total available and the flow is not controlled at the reformer.

Cracked naphtha is added under flow control and represents a certain



CONTROL LOOP for No. 1 furnace and reactor. For more sophisticated operation chemical injection can be controlled. Fig. 3.

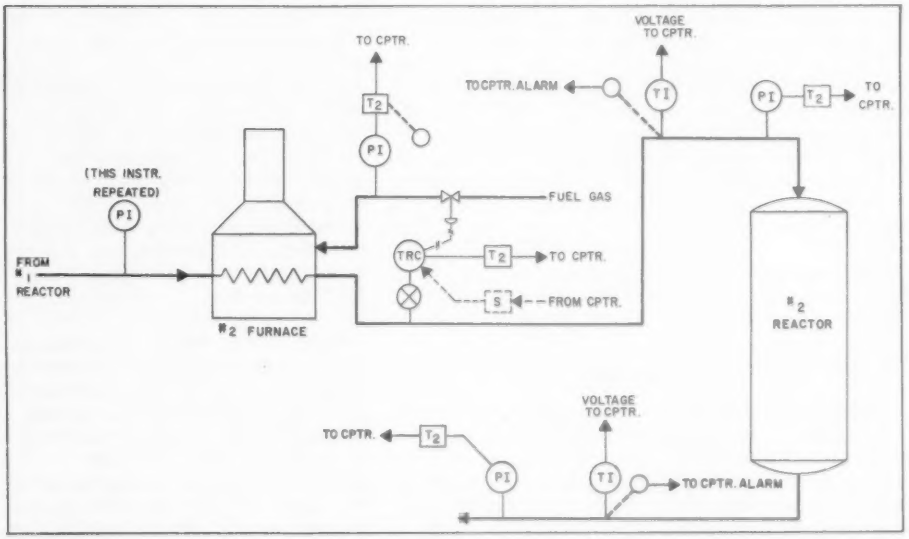
percentage of the total reformer charge. The straightrun gasoline makes up the charge - tank level on level - control. Control modes of the cracked naphtha and the straightrun gasoline can be reversed if desired in a particular plant.

The computer sums the individual flow recorders and compares this with the reformer charge flow as an accuracy check. Either the cracked-naphtha flow or the straightrun-gasoline flow is varied by the computer without changing the charge-tank level set point.

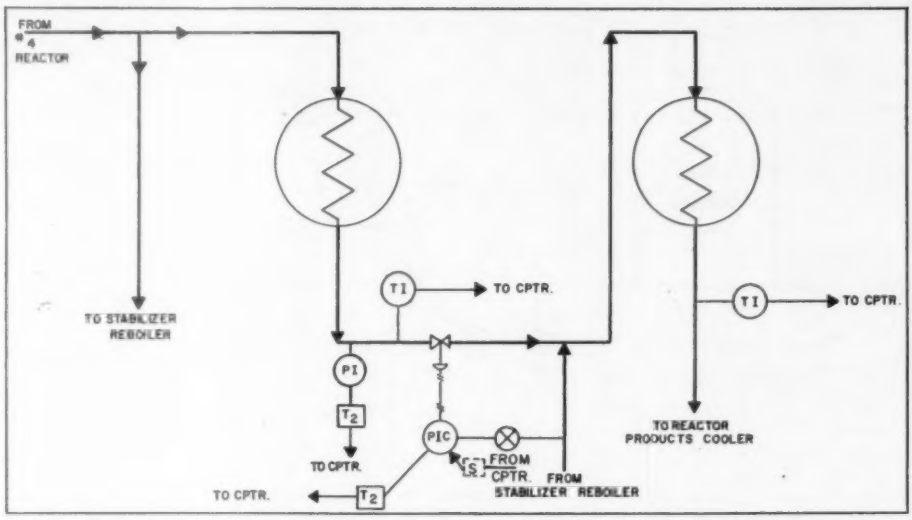
A specific-gravity recorder is shown on the reformer charge. It is assumed that the initial and end boiling points on the three streams are known and at least roughly controlled upstream of the reformer. In some cases it is desirable to replace the specific-gravity sensor with a 95%-point or end-point recorder.

Though not shown, an alarm at this point activated by a slug of especially heavy material (say, above 430° F. e.p.) may be desirable, especially if only one naphtha stream is charged to the reformer. Alarms are shown for high and low charge-tank level and failure of total-charge flow.

In the latter case, an alarm sounds giving the operators a specified time to correct the difficulty, after which an emergency instruction from the com-



CONTROL LOOP for remaining furnaces and reactors. Operation is the same as that for the No. 1 furnace and reactor. Fig. 4.



REACTOR-EFFLUENT FLOW through the reactor effluent-feed preheat exchangers. Fig. 5.

puter begins a plant shutdown by reducing fuel to the furnaces, unless the computer is overpowered by the operators. The alarm also warns the operators to stop other feeds to the reformer.

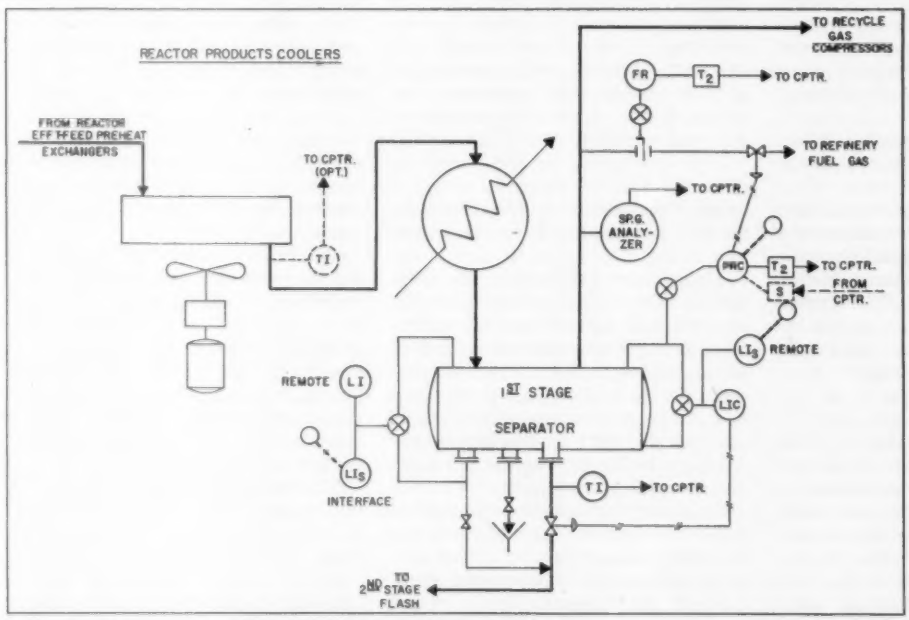
In case of low tank level, indicating a possible failure of the straight-run-gasoline stream, the cracked-naphtha flow control is reset by the computer which adjusts also the downstream controls according to the computer program and information from the specific-gravity analyzer.

The pressure point on the charge-pump discharge is an additional check. Low pressure here shows pump failure, serious system leakage, or instrument-air failure (the flow-control valve is spring-opening).

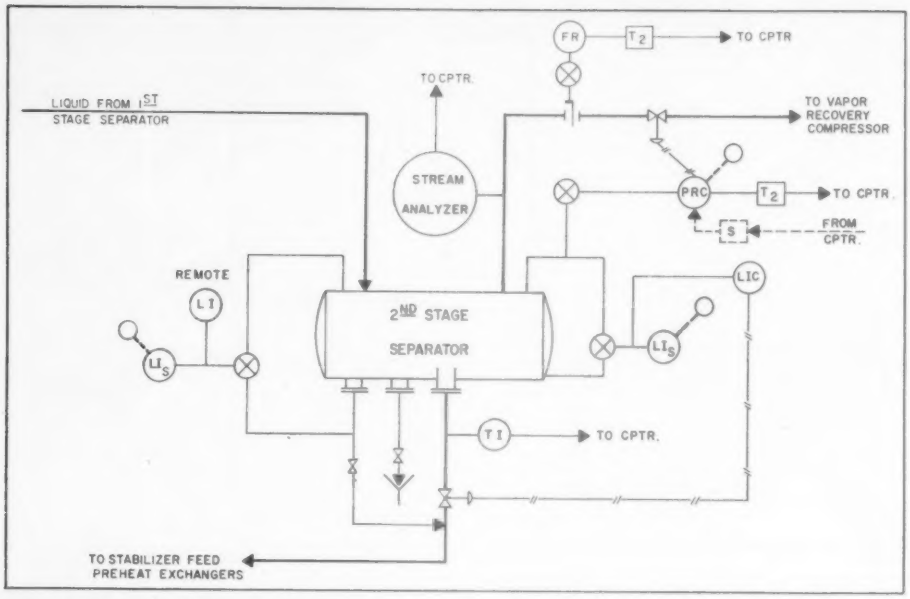
In all cases the operators are alerted by the computer or by the conventional alarm system and the computer initiates the appropriate control adjustments.

Gas blanketing of the charge tank is not shown. If gas blanketing is present, sometimes it can be used to increase charge-pump pressure or charge flow. This is especially true if the reformer is being charged to the limit, as for example, near catalyst regeneration time and with an inadequate charge pump. A total of eight inputs and two outputs is indicated for the computer control loop as shown.

Furnace and reactor. Fig. 3 shows the No. 1 furnace and reactor control loop. Reactor temperature is controlled by adjusting fuel to the furnace. Signals from the computer reset the TRC at the furnace outlet (reactor inlet) as catalyst activity decreases and in response to changes in the yield, throughput, and octane demands. Fuel gas to the reformer is measured in this con-



REACTOR-PRODUCTS COOLERS and first-stage separator. Reactor products are cooled both by a fin-fan cooler and a water-cooled exchanger. Fig. 6.



SECOND-STAGE SEPARATOR is not found in many reformers. Pressure differential between the first and second stage allows large amount of light hydrocarbons to flash in second stage. Fig. 7.

trol loop for the calculation of reformer fuel costs.

Pressures are sensed at the furnace inlet and outlet and at the reactor outlet. A high-pressure differential across the furnace indicates a plugged tube. A low-pressure differential indicates a tube leak. A high differential pressure across the reactor might indicate a badly coked catalyst bed.

Thermocouples are installed on the feed preheat-exchanger outlet and on the inlet and outlet of the reactor. Temperature drop across the reactor is used by the computer in judging the extent of aromatization taking place in the reactor and is also an indication of catalyst activity.

The three thermocouples shown actuate high-limit alarms for equipment and process protection.

An improvement over the scheme pictured for closer temperature control consists of the thermocouples placed at various levels in the catalyst bed to sense the temperature profile. System sophistication is added by alarms on the pressure differentials across the furnace and across the reactor.

Pressure on the fuel gas at the furnace burners is also sensed and furnished with a low-limit alarm. Since this pressure is the result of at least one upstream pressure reduction, a low pressure here indicates instrument failure or fuel-gas-supply failure, and in any case means trouble and the possibility of a plant shutdown. The computer begins action based on other process inputs.

Chemical injection to inhibit catalyst poisons, if done at all, is done upstream of the No. 1 furnace. This is shown between the two feed-preheat exchangers. Such injections are frequently made with proportioning pumps, since flow may be less than 5 gal. per hour. Process-licensor recommendations must be followed here. The check valve between the injection point and the pressure-sensing point in the injection line is not shown.

Complete supervisory control by the computer includes control of chemical injection. As many as three control computer subloops are added by chemical injection, each consisting of at least one computer input and one output. Fig. 3 shows 10 computer inputs and 1 output.

Fig. 4 is typical of the remaining three furnace and reactor control loops. Operation is as described for the No. 1 furnace and reactor control loop in Fig. 3.

Temperature drop across the three downstream reactors cannot generally be used as an indication of aromatization. A decreasing temperature drop across reactors Nos. 3 and 4 may mean severe hydrocracking; the control computer is programed to recognize this and take appropriate action, based on the stored program and other process-information inputs.

Since all reactor-inlet temperatures may be varied simultaneously, all furnace and reactor control loops may be considered as one loop from the standpoint of the computer, even though separate reset signals are issued to the individual TRC's. As knowledge of the process increases, the computer program is changed to reset the TRC's individually. When considered as one loop, 28 computer inputs and 4 outputs are required.

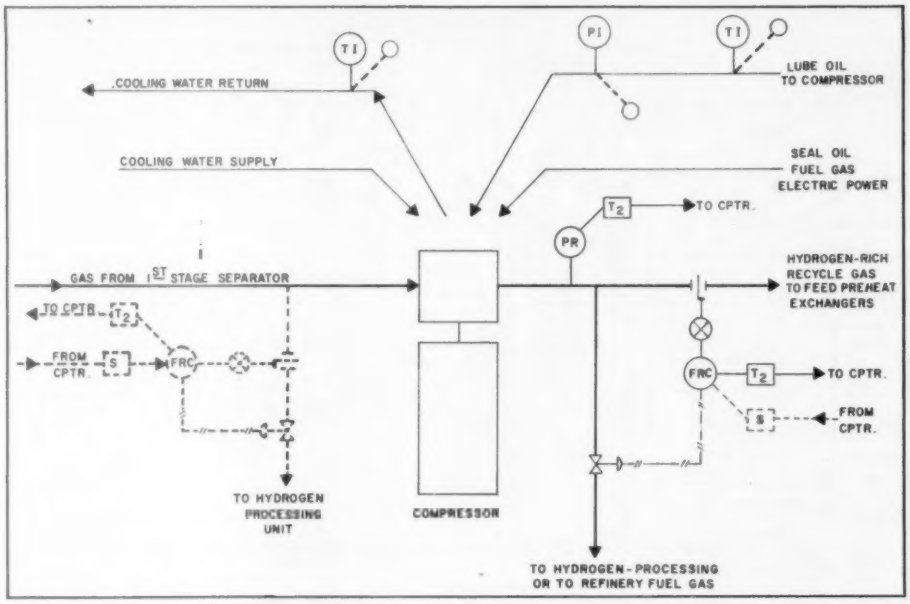
Exchangers. Fig. 5 shows the reactor-effluent flow through the reactor effluent-feed preheat exchangers. This cannot be termed a control loop from the computer standpoint. Two temperature and two pressure inputs to the computer are shown. Temperature inputs allow the computer to calculate heat balances around each exchanger. In the actual plant neither thermocouple may be required for control.

Complete supervisory computer control requires that the pressures be sensed both upstream and downstream of the control valve for exchanger pressure-drop indication, if for nothing else.

The flow of reactor effluent to the stabilizer reboiler (see Fig. 9) is controlled by a control valve at the reboiler and by the control valve between the feed-preheat exchangers in Fig. 5. Because of the high temperature of the reactor effluent, temperature control of the stabilizer reboiler is a weak point in many reformer control systems.

Deleterious interaction between the two control valves shown is avoided by incremental rather than continuous reset of PIC in Fig. 5 by computer.

Alternatively, it is possible for the computer to vary the reactor-effluent flow to the reboiler by resetting the PIC in Fig. 5 on the basis of informa-



INCOMPLETE CONTROL scheme for compressor control loop. Fig. 8.

tion from a themocouple or temperature recorder on the reboiler effluent to the stabilizer, and the reformate stream analyzer.

Fig. 6 includes the reactor-products coolers and the first-stage separator. Reactor products are shown cooled both by a fin-fan cooler and a water-cooled exchanger.

For complete supervisory control, propeller-pitch control or driver-r.p.m. control on the fin-fan exchanger and water-flow control to the other exchanger were discussed previously.

If chemical injection is used, a water level is generally carried in the separator and a high-level alarm is installed. Periodically, the water is drained by the operator. This function is assumed by the computer with sophisticated control. Charge to the second-stage separator is on level control.

Reactor pressures are controlled by the PRC on the first-stage separator. This pressure, together with compressor controls and the quality of the separator gas, permits adjustment of the hydrogen-recycle rate.

The quality of the separator gas is measured by a specific-gravity analyzer which is calibrated to indicate hydrogen content of the gas. The hydrogen content, the sensed flow, and the separator pressure as inputs to the computer allow calculation of the hydrogen from the process to the fuel gas.

Optionally, a gas chromatograph in place of the specific gravity analyzer would furnish a complete analysis of the separator gas and more knowledge of the process.

Second-stage separator. The second-stage separator shown in Fig. 7 is not present in many reformers. A 200-psi. or more differential exists between the first and second-stage separators and a large amount of the lighter hydrocarbons is flashed in the second-stage separator.

Liquid is charged to the stabilizer on level control and the vapor to vapor recovery or fuel gas on pressure control. In some cases the compressors in the vapor-recovery unit may control the pressure in this stage. The vapor is analyzed and the flow recorded.

On the basis of these and the separator pressure, the computer calculates the amounts of hydrocarbons leaving the process, including the amounts of valuable reformate components lost here.

The level-control scheme is identical to that for the first-stage separator. The separator temperature is sensed by a themocouple in the liquid leaving the separator.

Compressors. An incomplete control scheme is shown in Fig. 8 for the compressor control loop. Reformer compressors vary greatly in type, and because of the low compression ratio (generally less than 1.5 to 1) can include centrifugals. Compressors are normally furnished complete with all auxiliaries, instrumentation and alarms, including individual control boards.

If the compressor is driven by an electric motor with no variable coupling, hydrogen recycle rate to the process can be controlled by the first-stage-separator pressure and/or the FRC (if any) on the compressor discharge.

Hydroben content of the gas, the compressor discharge pressure and the recycle gas flow rate are required as inputs to the computer for calculation of the hydrogen-to-hydrocarbon mol ratio.

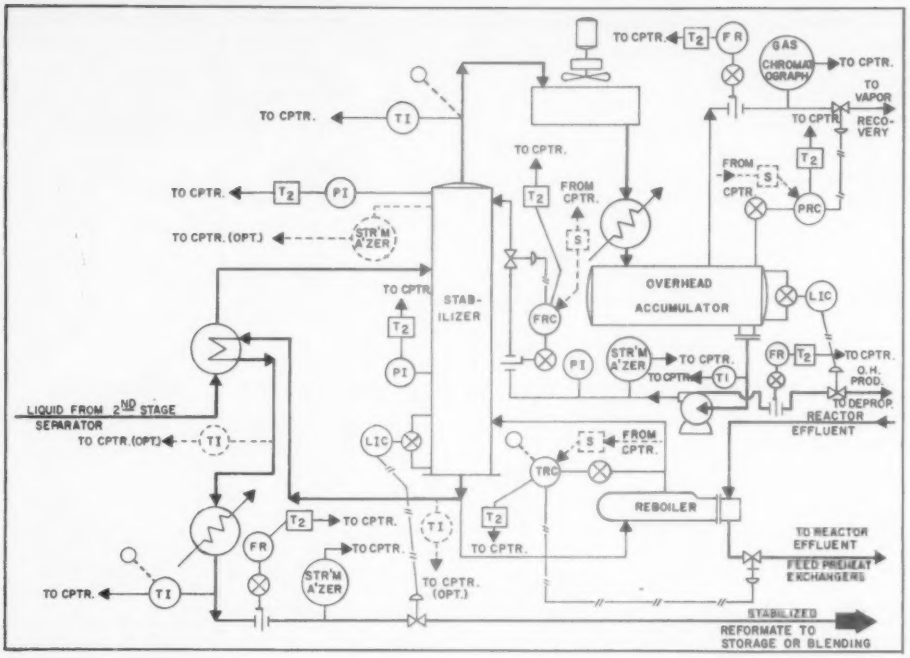
An alternate scheme is a flow recorder on the first-stage-separator vapor and controls on the flows of all gas streams other than the recycle gas. The computer in this case adjusts all controlled flows so that the recycle gas flow is as desired.

If the compressor r.p.m. is controllable, another means of controlling the hydrogen recycle rate exists. For reciprocating compressors, computer-controlled clearance pockets can effect fuel or electrical-power savings under varying compressor loadings.

It is possible for the hydrogen-to-hydrocarbon ratio to change in the process without a variation in the operating conditions. An increase in the pressure drop through the furnaces and reactors or a drop in the compressor efficiency both cause a reduction in the hydrogen-hydrocarbon ratio. A decrease in the hydrogen content of the recycle gas because of changing feed quality also causes a reduction in this ratio.

Stabilizer. Fig. 9 shows the stabilizer control loop.

Liquid from the second-stage separator is preheated by heat exchange with the stabilizer bottoms and charged to the stabilizer. Reboiler heat is on reboiler-effluent temperature control. The set point of this instrument is ad-



STABILIZER CONTROL LOOP. Liquid from the second-stage separator is preheated by the stabilizer bottoms and charged to the column. Fig. 9.

justed by the computer on the basis of information from the stream analyzer on the stabilized-reformate stream. This stream analyzer may be calibrated merely to analyze the C_4 content of the reformate.

Stabilized reformate flow is on level control from the stabilizer.

A close approach to flooding, representing the maximum throughput limit of the stabilizer, and incidentally most efficient fractionation, is sensed by the computer from the pressure differential across the stabilizer.

Stabilizer reflux is on flow control with the set point adjusted by the computer from the thermocouple in the stabilizer-overhead vapor line and the overhead - product stream analyzer. This is in effect temperature control and internal-reflux control for control of overhead products composition.

The gas chromatograph analyzes the overhead - accumulator vapor, which with the flow recorder on this stream, permits material-balance calculations around the stabilizer or the whole plant.

Much the same reasoning applies to the liquid overhead product. The stabilizer-overhead vapor is shown cooled by a fin-fan unit and condensed in a water-cooled condenser. As with the reactor products coolers, some computer control of the fan and water flow is practicable.

An optional stream analyzer is shown in phantom near the top of the stabilizer. Sensitized to detect small amounts of bottoms product in the liquid or vapor at a tray near the top of the column, these analyzers have proved successful in monitoring fractionator efficiency.

There is also the possibility of time-sharing the gas chromatograph on the stabilizer-overhead gaseous product so that the second-stage-separator vapor can be analyzed on the same instrument. Computer-controlled valve manifolding can then eliminate one stream analyzer.

Optimizing Economics

A process having no unpredictable variation in process or utilities variables should not require a control system. Conventional controllers can handle variations which are unpredictable but controllable.

Human operators adjust controller set points for variables which are unpredictable and not otherwise controllable by conventional controllers. This is due to the fact that conventional controllers alone are incapable of evaluating the interdependence of process variables.

The basis of this evaluation is economics. The economic relationships involved are complex. It is very difficult for the human operator to make the optimum decision as rapidly as required for process optimization.

For the catalytic reformer, the annual profit equation which should be optimized is:

$$Z = \Sigma P_i V_i - \Sigma N_j V_j - \Sigma U_k V_k - C - M - L - O - F$$

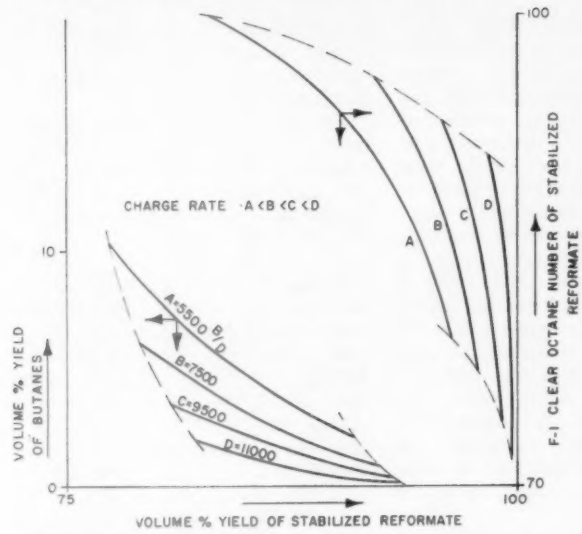
where

Z = annual net profit.
P = annual production of any product.
N = annual consumption of any charge stock.
U = annual consumption of any utility.
V = unit value or cost of a product, feed, or utility.
C = annual catalyst cost.
M = annual maintenance cost.
L = annual direct labor cost.
O = annual overhead or burden.
F = annual fixed costs.

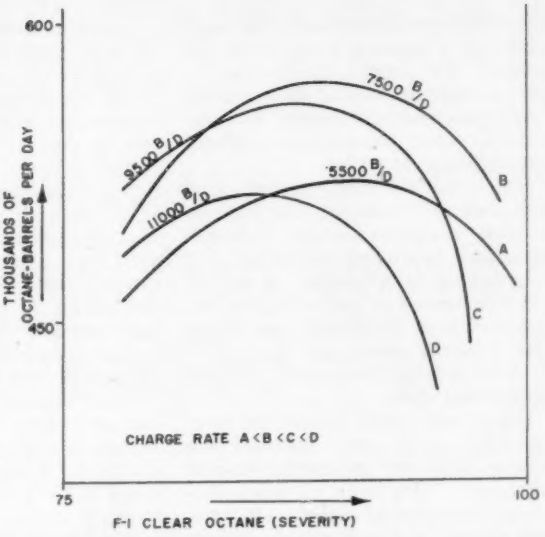
Net profit. It is plain that net profit is optimized by maximizing $\Sigma P_i V_i$ and/or by minimizing one or more of the other terms in the right-hand side of the equation. A definition of each term in this equation with respect to its significance for the reforming process permits the use of the equation in optimizing control.

The greatest economic advantage possible by computer optimization of the reformer is gained by maximizing the term $\Sigma P_i V_i$. The reformer produces reformate, butanes, hydrocarbon vapors for recovery, hydrogen, and fuel gas.

Many operators take no credit for the fuel - gas production, especially since the reformer is usually not self-



YIELD-OCTANE RELATIONSHIP for various charge rates. Fig. 10.



OCTANE-BARRELS plotted as a function of severity for various charge rates. Fig. 11.

sufficient in this respect. Hydrogen is generally used for feed preparation for the reformer, and in this case no credit can be taken for it. Depending on accounting procedures in the company, credit may be taken for hydrocarbon vapors going to vapor recovery.

Credit should be taken for butanes which are the second most valuable product. But few if any reformers exist in which any of these byproducts affect plant economy to the point of controlling operation. The plant is operated to optimize reformate production.

Reformate production. Optimizing reformate production means neither maximizing throughput nor maximizing octane number. In fact, Fig. 10 shows that the two tend to be mutually exclusive.

The dashed lines in Fig. 10 show process limits as imposed by equipment, catalyst considerations, or other process constraints.

It is plain that as charge rate increases, less octane improvement is possible. As octane increases for any charge rate, yield decreases. Apparently, for a given charge rate a product octane and a yield exist which together are the optimum condition for that charge rate. The "octane-barrel" was invented as an arbitrary unit to allow consideration of this condition.

Fig. 11 shows severity - octane plotted versus octane-barrels at various charge rates. Severity (temperature) and octane number bear an almost linear relationship and can be considered as one. Some idea of the complexity of the problem is shown in Fig. 11, once it is realized that maximum octane - barrels have no simple relationship to throughput and severity.

Now we approach one of the most important concepts in this paper. An operator is forced to examine any product of his plant from the standpoint of what the value of that product is to him.

Naphtha, charged to the reformer, as a product of the atmospheric crude tower is worth as much as its equivalent in crude oil plus a crude-processing charge. But as a reformer charge stock it takes on more value because of its potential in the reformate. Likewise, reformate has a potential value as a blend component in finished motor fuel or aviation gasoline.

The value of reformate to the operator does depend upon yield and octane, but also upon the quantities, values, and blend-octane potentialities of other components of the finished gasoline.

It is here that the octane-barrels concept for reformate value breaks down. Carrying this reasoning one step further, it is plain that if reformate is used in more than one blend of finished gasoline, it has a value that depends upon the blend to which it is added.

Optimizing the reformer process without regard to the blender can be done on the basis of octane-barrels. But optimum yield and octane will almost certainly be different if examined from the logical standpoint of the finished salable gasoline. Into this gasoline may also be blended polymerized or cat cracked gasolines, alkylate, butane, isopentane, and TEL.

The objective is to get the maximum net profit for the complete refinery. No purpose is served if it is possible to substitute other available cheaper blend stocks and additives for reformer octane-barrels.

The first problem then is to determine the finished-blend composition which will meet specifications and have the minimum cost. The finished-blend selling price will already have been at least roughly fixed by competition. The amount of bulk blending stock to be used is decided upon. The difference between its characteristics and the desired blend must be made up by reformate, butane, TEL, and other octane-improving blend stocks. Previous experience will show the blend compositions which will meet specifications.

Setting the net profit equal to zero in the profit equations of the reformer and of the other units contributing to the blend, the gross cost of each component is computed. These costs are obtained for each condition of operation of the individual unit which results in adequate characteristics and yield of the blend component.

The problem is further complicated by the fact that a component such as reformate or alkylate may be used in two or more blends simultaneously.

In this case several finished-blend cost equations must be solved simultaneously to permit optimization of the over-all operation. That blend having the lowest gross cost, including the cost of blending, is the optimum choice.

The problem of optimum blend selection is sufficiently complex to jus-

tify computer techniques in the solution and a separate paper on the subject. The problem can be made a part of the program of the reformer optimizing control computer. By comparison other computation methods are decidedly too slow.

Once the optimum finished-blend composition is selected, the process-control computer adjusts reformer conditions to produce the desired yield and quality of reformate. A net annual realization of up to $50,000 additional for a 10,000-bbl. per stream day reformer alone may be possible with analysis of the over-all problem as outlined above.

Optimized in this manner reformer operation is in many instances less severe than was previously believed necessary. This leads to more dividends in increased catalyst life, utilities savings, and maintenance savings.

Overhead and labor. After installation, the computer can do nothing to minimize the last three terms of the profit equation; all possible savings here will have been realized by virtue of the computer installation. Economies are possible in the remaining four negative terms of the equation.

Maintenance. Maintenance can be considered as minor and major. Minor maintenance is the day-to-day repair required in all plants, performed without considerable disturbance to the process. Major maintenance requires a plant shutdown.

Against the reformer for each shutdown is not only the cost of the maintenance but also the penalty for lost produtcion. For a 10,000-bbl. per stream day reformer realizing 80% yield, and for 8-cent per gallon charge stock with 4-cent per gallon upgrading of the charge stock, a loss in gross profit alone of $6,720 per day results from reformer down time. Obviously, better scheduling of down time for maintenance saves money.

Catalyst life. Catalyst cost can be expressed as a certain charge per barrel, by dividing the cost of the catalyst by the number of barrels throughput.

Likewise, catalyst life can be expressed as the number of barrels throughput processed by each pound of the catalyst up to the time of regeneration or replacement.

Other than the gradual attrition in catalyst activity experienced with normal use, accidental severe hydrocracking, upset of the hydrogen recycle rate, and upredictable variations in the charge-stock quality can all reduce catalyst life.

Those catalysts which can be regenerated are operated from 12 to about 20 weeks between regenerations. If periods of 5 and 8 days, respectively, are assumed for shutdown, and regeneration and startup, service factors of about 94.5% are applicable.

Should closer control by the computer make possible an increase of 0.5% in service factor (1.75 days' more operation per year) by extending the time between regenerations, a gross profit increase of $11,760 is realized for the 10,000-bbl. per stream day reformer. This figure is believed to be conservative especially in view of probable less severe operation.

More economy is realized by extending catalyst life. A catalyst which is regenerated every 12 weeks can frequently be regenerated six or more times for a total catalyst life of 72 weeks or more.

Catalyst which can no longer be regenerated is returned for credit. Most of the platinum can be reclaimed and placed on a new catalyst support. The charge for new catalyst in exchange for old is about $4 per pound. Assuming 55,000 lb. of catalyst is involved, $220,000 is the cost of the replacement catalyst.

If total catalyst life between replacements is 72 weeks, annual catalyst cost is $159,000. This is a cost of 4.6 cents per barrel of charge stock. For a 2-week extension of the catalyst life, annual saving of $4,400 is gained.

Reforming catalysts purchased for a new plant must of course be bought outright. Bought in this manner, the catalyst is $10 to $12 per pound. Many operators prefer to account for this cost from the reformer profits as soon as possible. This can affect the philosophy of operation and must be considered in optimization.

Optimum catalyst life is determined by comparing savings due to catalyst-life extension with the cost of selectivity losses as catalyst activity declines. Catalyst cost per barrel decreases as the total throughput accumulates. Simultaneously, the value of the per barrel yield losses increases. When the two are equal, catalyst should be regenerated or replaced.

Yield loss here must be calculated on the basis of freshly regenerated or replaced catalyst. If reformer operating conditions, charge rate, or charge composition have changed since the previous regeneration, a theoretical yield equivalent to maximum catalyst activity is calculated for present operating conditions.

Utilities. Fuel gas, electricity, and cooling water are the principal reformer utilities, generally in order of decreasing cost per barrel. Since optimizing computer control of the reformer will normally result in less severe operation, savings are effected in all utilities.

For our 10,000-bbl. per stream day reformer, a fuel cost of 5 cents per barrel of charge can be assumed. A 5% saving in fuel because of closer control means an annual saving of $8,625.

Charge stock. Charge-stock savings are due principally to process-selectivity increases. A ½% increase in yield of stabilized reformate nets over $200 per day for the reformer on the basis of 10,000-bbl. per stream day charge rate, a previous 80% yield and 8-cent per gallon charge stock with 4 cents upgrading advantage.

If the reformer is charged at the rate of 8,000-bbl. per stream day with the same per cent yield, a net realization of over $160 per day results.

With the reformer now controlled to produce reformate of the quantity and quality required for optimization of the over-all operation, a reevaluation of the charge stock is in order. It is entirely possible that less charge stock is required. Any selectivity increases in reformer operation further reduces charge-stock requirements. This may make advisable a shift in the cut point between straightrun gasoline and naphtha in the crude tower, which will give more savings.

Other savings. Increases in the reformate octane number due alone to closer control by the computer are difficult to evaluate in dollars. On the basis of 5.25 cents per octane-barrel, each increase of 1/10 octane number gives a net profit increase of over $40 per day for 8,000-bbl. per stream day of reformate.

As shown earlier, this analysis does not apply to over-all optimization. The additional savings must be computed on the basis of finished-gasoline cost, since a higher reformate octane allows the use of more of the less expensive bulk blending stock.

Most of the figures presented in this portion of the paper were based on a reformer designed for a charge rate of 10,000-bbl. per stream day. Almost the same investment in stream analyzers, transducers, and computer hardware applies regardless of the size of the reformer.

On the other hand, profit increases tend to be percentages. A reformer charging 30,000-bbl. per stream day, all else being equal, would have three times the profit increase in dollars of the smaller plant. In this case the payout on the optimizing-control-computer system will be rapid.

Journal Survey of Refineries in the United States

Location and Capacities as of January 1, 1960

State	No. Plants	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels Per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydro-treating	Production — Barrels Per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Alabama	4	15,850	18,400	10,350	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,100
Arkansas	6	84,940	88,450	45,400	13,000	32,700	8,500	16,740	22,500	3,500	2,300	4,600	400	9,090
California	37	1,341,095	1,408,448	551,785	523,395	364,455	122,680	234,905	221,445	49,535	3,980	22,970	3,580	67,170
Colorado	7	37,100	41,800	5,200	13,200	11,300	5,300	7,650	.....	.....	1,300	.....	.....	1,200
Delaware	2	143,500	153,685	92,540	42,000	58,000	44,000	45,000	88,000	5,000	5,100	.....	1,200	1,665
Florida	1	2,000	2,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,100
Georgia	1	7,000	8,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,000
Illinois	13	598,500	627,050	175,780	121,055	267,470	60,640	148,645	162,275	31,145	10,410	4,800	1,880	34,655
Indiana	12	489,100	523,850	182,200	138,000	168,150	23,100	116,100	96,400	15,160	3,750	10,250	1,865	21,500
Kansas	13	331,600	351,005	86,200	60,300	126,500	61,800	71,300	28,800	20,400	4,700	3,600	990	21,050
Kentucky	4	103,000	110,550	32,000	10,500	36,400	15,200	9,000	12,500	.....	4,400	.....	.....	12,000
Louisiana	12	777,610	810,000	225,315	113,000	331,600	159,100	134,250	31,400	52,700	12,215	12,130	325	13,485
Maryland	3	30,000	36,500	18,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	20,600
Massachusetts	1	50,000	55,000	13,100	.....	20,000	15,000	7,200	7,200	.....	1,800	.....	.....	10,000
Michigan	14	171,900	184,560	56,500	23,700	64,200	15,000	27,750	33,350	5,550	2,950	.....	350	13,300
Minnesota	4	66,785	69,500	10,000	12,000	26,000	15,000	7,800	18,800	.....	1,970	.....	600	5,000
Mississippi	3	16,200	18,500	2,500	4,800	9,300	16,300	2,500	1,200	2,500	.....	.....	225	3,200
Missouri	1	76,100	78,500	7,200	29,480	35,500	2,000	14,000	20,000	3,800	2,200	.....	400	3,000
Montana	10	85,515	95,820	26,000	19,705	31,200	20,500	11,250	39,800	2,300	5,155	.....	200	14,975
Nebraska	1	2,800	3,000	.....	1,100	.....	.....	650	.....	.....	.....	.....	.....	.....
New Jersey	8	573,050	604,740	231,115	63,725	181,440	31,000	80,135	157,290	18,155	6,780	8,000	800	24,600
New Mexico	5	27,980	29,900	5,900	1,875	8,850	3,900	3,950	2,500	2,000	.....	.....	.....	2,100
New York	3	89,000	93,050	21,300	.....	47,240	12,500	16,400	18,900	3,000	3,200	.....	.....	5,300
North Dakota	2	43,200	46,000	.....	1,000	18,000	7,000	6,700	.....	1,800	1,440	.....	.....	.....
Ohio	11	425,720	454,920	87,200	84,560	207,390	86,000	86,835	59,500	12,455	13,205	3,600	790	20,200
Oklahoma	14	406,680	425,505	121,330	88,255	163,765	64,600	72,770	61,390	18,455	9,065	11,150	1,185	10,500
Oregon	1	3,800	7,000	7,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,500
Pennsylvania	13	670,300	707,050	221,600	129,590	248,780	62,660	165,455	178,015	20,580	8,245	28,645	.....	10,225
Rhode Island	2	14,700	15,475	1,840	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,665
South Carolina	1	11,440	13,000	10,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,949
Tennessee	1	18,500	20,000	6,500	.....	7,000	2,000	.....	.....	1,200	500	.....	.....	3,000
Texas	57	2,561,920	2,714,535	840,215	458,820	974,195	220,385	543,205	576,690	122,545	28,045	70,380	515	45,100
Utah	5	99,700	103,110	30,000	8,500	37,900	11,500	16,100	1,000	5,000	1,100	.....	.....	2,850
Virginia	1	36,800	38,000	21,000	14,000	22,000	9,000	7,600	22,600	.....	2,500	.....	700	.....
Washington	6	152,500	164,370	59,945	8,900	67,575	20,700	29,945	41,890	6,355	6,720	.....	.....	7,700
West Virginia	2	6,870	7,000	2,000	2,150	.....	.....	2,500	2,500	.....	155	1,600	.....	.....
Wisconsin	2	19,250	20,500	7,000	1,500	.....	.....	3,300	5,200	.....	.....	.....	.....	3,700
Wyoming	9	107,950	117,395	42,875	21,445	46,235	4,600	15,745	20,245	2,590	2,285	840	193	12,065
Puerto Rico	2	89,400	94,500	59,200	20,000	42,500	23,600	7,460	10,000	1,700	2,830	.....	.....	.....
Total	294	9,789,355	10,360,868	3,317,090	2,029,555	3,655,645	1,143,565	1,912,840	1,941,390	407,425	148,300	182,565	16,198	434,544

Where the plants are, their capacities, and types of processing

LEGEND

Processes in table are identified by numbers:

THERMAL PROCESSES
1. Gas-oil cracking
2. Visbreaking
3. Naphtha reforming
4. Fluid coking
5. Delayed coking
6. Batch coking
7. Polyforming
8. Cracking, general
9. Residuum cracking
10. Clarified cracking

CATALYTIC CRACKING
1. Fluid
2. Thermofor
3. Houdriflow
4. Houdry
5. Cycloversion

CATALYTIC REFORMING
1. Platforming
2. Fluid hydroforming
3. Fixed-bed hydroforming
4. Houdriforming
5. Ultraforming
6. Catforming
7. Sinclair-Baker
8. Powerforming
9. Rexforming
10. Iso-Plus
11. Hyperforming
12. Cycloversion
13. Socony-Mobil
14. Thermofor
15. Own
16. Undefined

NR—Not reported

CATALYTIC HYDROGEN TREATING
1. Unifining
2. Esso Hydrofining
3. Indiana Hydrofining
4. Hydrotreating
5. Gulfining
6. Houdry
7. Shell vapor phase
8. Shell Trickle
9. Diesulforming
10. Sinclair
11. Kellogg
12. Platreating
13. Socony-Mobil
14. Own
15. Undefined
16. Hydrobon

ALKYLATION
1. Sulfuric acid
2. Hydrofluoric acid

POLYMERIZATION
1. Thermal
2. Catalytic

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Alabama														
American Bitumuls & Asphalt Co.:														
Mobile (Blakely Island)	5,300	6,500	6,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,200
Hunt Oil Co.:														
Tuscaloosa	7,500	8,000	3,850	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,000
Vulcan Asphalt Refining Co.:														
Cordova	1,800	2,400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,100
Warrior Asphalt Corp.:														
Holt	1,250	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	800
Total	15,850	18,400	10,350	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,100
Arkansas														
American Oil Co.:														
El Dorado	40,000	42,000	20,000	[1]3,000 [5]10,000	[1]19,000	4,000	[5]12,240	[3]12,500	Naphtha	[2]1,500	[2]500	.....	400	.....
Berry Asphalt Co.:														
Stephens	1,800	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	500	.....	540
Waterloo	1,200	1,500	1,200	.....	.....	.....	.....	.....	.....	.....	.....	500	.....	550
Cross Co. of Arkansas, Henry H.:														
Smackover	4,300	4,300	1,200	.....	.....	.....	.....	.....	.....	.....	.....	800	.....	800
Lion Oil Co. Div. of Monsanto Chemical Co.:														
El Dorado	33,000	33,850	[1]6,000	.....	[1]6,700 [2]7,000	4,500	[1]4,500	[1]5,000 [1]5,000	Naphtha Mid. dist.	[1]2,000	[2]1,200	800	.....	5,550
Macmillan Petroleum Corp.:														
Norphlet	4,640	4,800	5,000	.....	.....	.....	.....	.....	.....	.....	.....	2,000	.....	1,650
Total	84,940	88,450	45,400	13,000	32,700	8,500	16,740	22,500	.....	3,500	2,300	4,600	400	9,090

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
California														
Caminol Co.:														
Hanford	7,500	7,500	.....	[1]700 [2]2,600 [3]350	.....	.....	[1]850	.....	.....	.....	[1]100	.....	.....	.....
Century Oil Co.:														
Long Beach	5,000	5,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Douglas Oil Co. of California:														
Bakersfield	8,450	8,800	.....	[1]4,600	.....	.....	[1]2,200	[1]1,300	Naphtha	.....	.....	.....	.....	.....
Paramount	6,650	7,000	5,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,500
Santa Maria	3,350	3,500	2,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,800
Edgington Oil Refineries, Inc.:														
Long Beach	6,000	7,000	7,000	.....	.....	.....	.....	.....	.....	.....	.....	1,400	.....	3,150
Oxnard	3,000	3,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,550
Envoy Petroleum Co.:														
Long Beach	3,000	3,160	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,500
Fletcher Oil Co.:														
Wilmington	9,500	10,000	.....	[9]14,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Golden Bear Oil Co.:														
Oildale	4,870	5,000	5,000	.....	.....	.....	.....	.....	.....	.....	.....	2,500	.....	1,750
Golden Eagle Refining Co., Inc.:														
Torrance	8,500	9,000	.....	[2]4,000	.....	.....	.....	.....	.....	.....	[2]80	.....	.....	.....
Macmillan Petroleum Corp.:														
Long Beach	8,000	9,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,700
Manespo Refining Co.:														
Long Beach	3,000	3,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mobil Oil Co. (formerly General Petroleum Corp.):														
Torrance	125,000	128,000	38,000	[2]28,500 [5]26,500	[2]28,000	24,000	[13]21,110	.....	.....	[2]3,700	[2]890	.....	1,100	.....
Mohawk Petroleum Corp.:														
Bakersfield	11,875	12,500	.....	[1]1,500 [2]3,170	.....	.....	[1]2,500	[1]925	Naphtha	.....	[2]60	.....	.....	.....
Newhall Refining Co., Inc.:														
Newhall	2,800	3,000	1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	900
Oxnard Oil & Refining Co.:														
Oxnard	1,800	1,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Palomar Oil & Refining Corp.:														
Bakersfield	1,300	1,300	.....	.....	.....	.....	.....	.....	.....	.....	.....	390	.....	520
Powerine Oil Co. (formerly Rothschild Oil Co.):														
Santa Fe Springs	14,000	15,400	.....	[1]5,000	.....	.....	[1]2,700	.....	.....	.....	[2]150	.....	.....	.....
Richfield Oil Corp.:														
Watson (Los Angeles County)†	165,000	173,700	63,000	[1]23,000 [2]29,000	[1]41,000 [2]19,500	22,000 10,500	[7]17,000	[4]8,000 [10]17,000	Cat. naph. SR naph.	[1]7,000	[2]1,900	.....	.....	.....
Seaside Oil Co.:														
Ventura	4,750	5,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shell Oil Co.:														
Martinez	55,000	58,000	11,600	[1]33,000	.....	.....	[1]5,800	.....	.....	.....	.....	3,300	.....	7,450
Wilmington-Dominguez†	68,000	70,000	42,000	[1]36,000	[1]24,000	5,000	[1]17,900	[7]22,000 [7]14,500	Naphtha Cat. naph.	[1]6,500	.....	.....	.....	230
Signal Oil & Gas Co. (doing business as Bankline Oil Co.):														
Bakersfield	10,000	10,200	.....	[1]2,500 [4]4,000	.....	.....	.....	.....	.....	[1]1,000	.....	.....	60	.....

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
CALIFORNIA (Continued)														
Socal Oil & Refining Co.:														
Huntington Beach	2,750	3,000	.....	[1]1,100 [2]1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Standard Oil Co. of Calif., Western Operations, Inc.:														
Bakersfield	26,000	NR	.....	‡[9]9,000	.....	.....	‡[5]5,000	‡[5]5,000	Naphtha	.....	.....	.....	.....	‡1,110
El Segundo	150,000	NR	‡76,000	‡[3]11,000 ‡[9]59,000	‡[40]40,000	‡15,000	‡[30]30,000	‡[20]20,000	Naphtha	‡[5]5,400	.....	.....	.....	‡8,325
Richmond†	210,000	NR	‡50,000	‡[7]7,500 ‡[9]50,000	‡[40]40,000 ‡[32]32,000	‡15,000 ‡10,000	‡[40]40,000	‡[40]40,000	Naphtha	‡[4]4,500 ‡[24]4,000	.....	‡10,000	.....	‡11,100
Sunland Refining Corp.:														
Bakersfield	4,500	4,730	.....	[2]1,100	.....	.....	[1]1,000	.....	.....	.....	.....	.....	.....	.....
Texaco Inc.:														
Wilmington†	60,000	NR	‡35,000	‡[1]10,000	‡[28]28,000	.....	‡[1]10,000	‡[9]9,000	Crkd. naph.	[1]4,400	.....	.....	.....	.....
Tidewater Oil Co.:														
Avon†	§135,000	¶142,000	74,500	[1]20,000 [4]42,000	[1]47,000	.....	[1]10,000 [4]22,500	[1]34,500	Naphtha	[1]6,000	.....	1,670	1,200	.....
Union Oil Co. of California:														
Arroyo Grande (Santa Maria)	21,500	24,500	.....	[5]15,000	.....	.....	.....	.....	.....	.....	.....	.....	720	.....
Rodeo (Oleum)	45,800	48,200	34,100	[1]15,000 [5]15,000	.....	.....	[1]14,500	[1]17,000	Naphtha	.....	.....	2,600	500	3,600
Santa Maria (Orcutt)	4,700	5,000	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,000
Wilmington (Los Angeles)†	109,000	115,000	87,000	[1]16,000 [2]18,500	[2]6,000 [2]16,000	8,000 8,000	[1]12,400	[1]14,000	Naphtha	[1]5,000	.....	.....	.....	6,700
West Coast Oil Co.:														
Oildale	3,500	3,685	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000
Wilshire Oil Co. of California:														
Santa Fe Springs	32,000	33,000	10,000	[1]7,000	[1]7,400	740	[1]10,000	[1]10,000	Naphtha	.....	[2]800	.....	.....	2,000
Total‖	1,341,095	1,408,448	551,785	523,395	364,455	122,680	234,905	221,445	.....	49,535	3,980	22,970	[2]2,580	67,170

*4,500-bbl. gas-oil cracking unit shut down. †The following butane isomerization units are operating: Richfield at Watson, 1,000 b.p.s.d.; Shell at Wilmington-Dominguez, 3,380 b.p.s.d.; Standard of California at Richmond, 2,000 b.p.c.d.; Texaco at Wilmington, 1,500 b.p.c.d.; Tidewater at Avon, 2,700 b.p.s.d.; and Union at Wilmington 1,500 b.p.s.d. ‡Barrels per calendar day. §Includes 27,000-bbl. standby capacity. ¶Includes 28,000-bbl. standby capacity. ‖State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Colorado

Bay Petroleum Co., Div. of Tennessee Gas Transmission Co.:														
Denver	10,000	11,000	3,000	[2]6,000	[1]4,500	2,000	[3]3,500	.....	.....	.....	[2]600	.....	.....	.....
Continental Oil Co.:														
Denver	15,000	18,000	.....	[1]4,300	[2]6,800	3,300	[1][3]3,500	.....	.....	.....	[2]700	.....	.....	.....
Empire Petroleum Co.:														
Denver	5,000	5,500	2,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,200
Oriental Refining Co.:														
Alamosa	1,000	1,000	.....	[1]600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Denver	3,300	3,300	.....	[1]1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skelly Oil Co.:														
Denver	1,400	1,500	.....	[1]800	.....	.....	[1]650	.....	.....	.....	.....	.....	.....	.....
Uinta Oil Refining Co.:														
Rangely	1,400	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	37,100	41,800	5,200	13,200	11,300	5,300	7,650	.....	.....	.....	1,300	.....	.....	1,200

How much does your finned tube dollar buy?

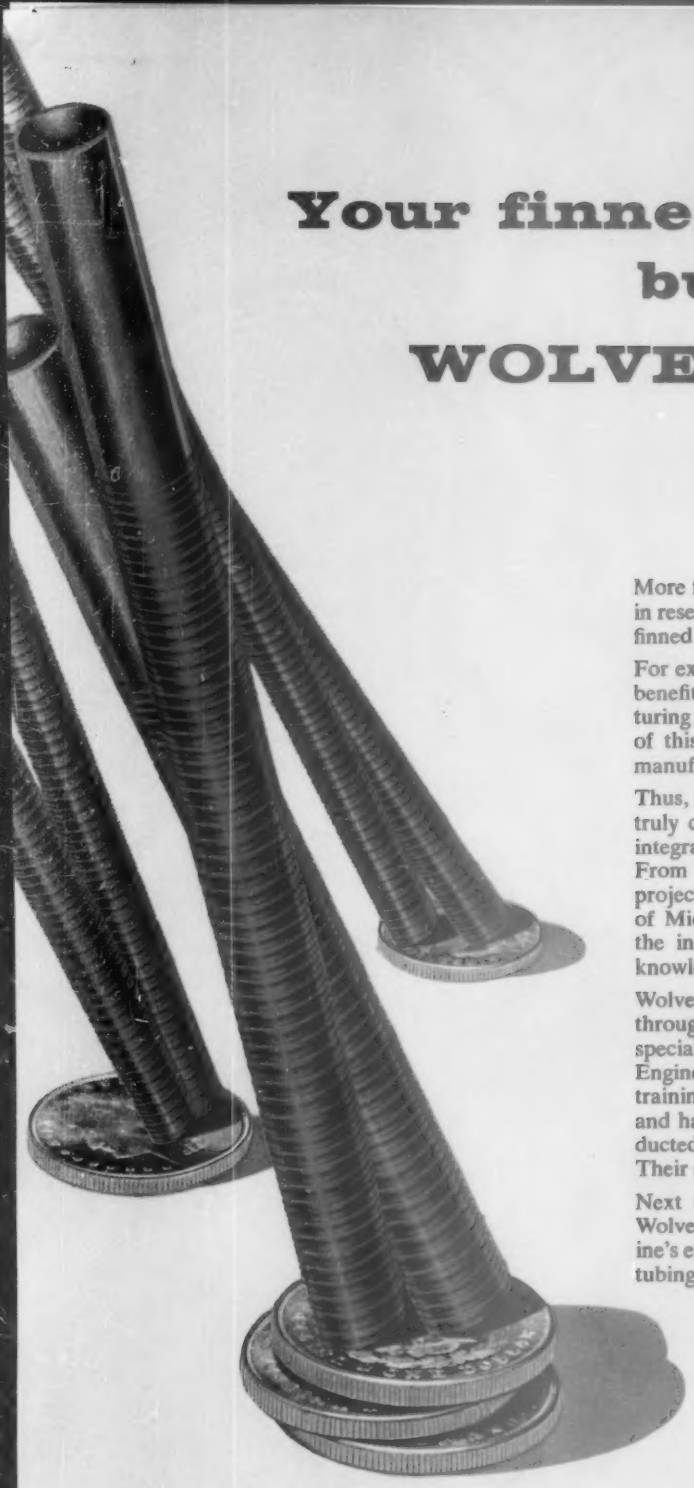
The answer is plenty—particularly when you buy Wolverine Trufin® Type S/T, the original, integrally finned tube.

Wolverine Tube developed this type of tubing and over the past 20 years has brought Wolverine Trufin Type S/T to a high degree of perfection. Through constant research and testing plus actual "on-the-job" data gathered from countless installations, it has proved the many money-saving ways in which this extended-surface tubing can help you.

FOR EXAMPLE:

- Type S/T has more than 2½ times as much outside surface area as a comparable piece of plain tube
- More surface area means more BTU's per foot of tube thus requiring fewer tubes to transfer a given heat load
- Fewer tubes means smaller shells, headers, baffles, etc.
- Less weight of tube metal to transfer a given heat load
- Lighter units require less structural support
- Integral fins are unaffected by vibration, thermal shock, or pressure variations
- Interchangeable with plain tube
- Available in complete size ranges in copper, copper alloys, aluminum and steel

Ask your Wolverine sales representative for complete information about Wolverine Trufin Type S/T. Write, too, for a free copy of the Trufin Design and Cost Comparison Book.



Your finned tube dollar buys more from WOLVERINE TUBE

More for your money . . . in products . . . in services . . . in research and development . . . these are the things your finned tube dollar buys at Wolverine Tube.

For example, *only* from Wolverine Tube can you get the benefits of more than 20 years of finned tube manufacturing experience. Wolverine is the original producer of this type of tubing — for many years was the sole manufacturer.

Thus, it is *only* from Wolverine Tube that you can obtain truly competent guidance concerning the proper use of integrally finned tubing in heat transfer applications. From its own research facilities, and from research projects carried on in conjunction with the University of Michigan, Wolverine has, over the years, compiled the industry's most comprehensive file of finned tube knowledge.

Wolverine makes this information available to you through its literature and through its staff of heat transfer specialists. These men—members of the Wolverine Field Engineering Service — have all undergone intensive training in finned tube technology in Wolverine plants, and have completed a process heat transfer course conducted by Dr. Donald Q. Kern, Wolverine consultant. Their services are yours at any time—without obligation.

Next time you specify integrally finned tube, consult Wolverine Tube before placing your order. Let Wolverine's experience help you obtain maximum value for your tubing dollars.

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DIVISION OF
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Allen Park, Michigan
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin is available in Canada through the Unifin Tube Division, London, Ontario.

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Delaware														
Texaco Inc.:														
Claymont	3,500	NR	*1,750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*1,500
Tidewater Oil Co.:														
Delaware City	140,000	150,000	90,700	[4]42,000	[1]58,000	44,000	[4]45,000	[1]30,000 [1]48,000 [1]10,000	Naphtha Mid. dist. Other	[1]5,000	[2]5,100	.....	1,200	.....
Total†	143,500	153,685	92,540	42,000	58,000	44,000	45,000	88,000	.....	5,000	5,100	.....	1,200	1,665

*Barrels per calendar day. †State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Florida														
Seminole Asphalt & Refining, Ltd.:														
St. Marks	2,000	2,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,100
Georgia														
American Oil Co.:														
Savannah	7,000	8,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,000
Illinois														
Advance Refining Co., Inc.:														
Centralia	3,000	3,000	.....	.....	[5]600	60	.....	.....	.....	.....	.....	.....	.....	.....
Clark Oil & Refining Corp.:														
Blue Island	35,000	35,500	14,000	[1]1,800	[1]14,000 [3]7,200	5,000	[1]7,200	.....	.....	[2]2,300	[2]600	.....	.....	.....
Cross Co., Henry H.:														
Colmar	1,000	1,100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mobil Oil Co.:														
East St. Louis	43,000	45,200	.....	[5]12,700	*[2]30,000	NR	[1]39,670	[1]316,000	Naphtha	[2]2,600	[2]700	.....	400	.....
Ohio Oil Co.:														
Robinson	48,800	50,000	18,050	[1]6,600	[1]22,000	8,000	[4]10,000	.....	.....	[1]2,600	[2]1,500	.....	300	.....
Pana Refining Co., Div. of Illinois Farm Supply Co.:														
Pana	5,000	5,500	.....	[1]2,500	.....	.....	[1]1,600	[1]1,600 [1]400	SR naph. Crkd. naph.	.....	[2]145	.....	.....	.....
Pure Oil Co.:														
Lemont	47,500	NR	.....	[1]3,000	[1]22,000	6,000	[7]12,000	[11]12,000 [11]5,000	Naphtha SR gaso.	[2]1,600	[2]1,800	.....	.....	5,500
Shell Oil Co.:														
Wood River†	186,000	196,000	71,500	[1]16,300 [3]16,800 [6]14,800	[1]64,000	20,000	[1]43,000	[7]21,000 [7]25,000 [7]13,000	Naphtha Mid. dist. Range fuel	[1]11,000	[2]1,250	4,800	900	13,100
Sinclair Refining Co.:														
Hartford (Wood River refinery)	29,000	31,000	12,000	[1]6,000	[1]11,000	580	[7]7,500	[1]07,500	Naphtha	.....	[2]800	.....	.....	1,500
Standard Oil Co. (Ind.):														
Wood River	65,000	67,500	24,970	.....	[1]30,000	21,000	[5]9,900	[3]13,000	Naphtha	[1]3,600	[2]170	.....	.....	8,000
Texaco Inc.:														
Lawrenceville	67,000	NR	‡20,000	‡[1]12,000	‡[1]30,000	.....	‡[1]24,000	‡[1]24,000	SR naph.	‡[1]2,300	‡[2]2,500	.....	.....	‡2,700
Lockport	67,000	NR	‡13,500	‡[1]15,000 ‡[3]9,500	‡[1]30,000	.....	‡[1]19,000	‡[1]19,000	SR naph.	‡[1]4,400	‡[2]600	.....	‡250	‡3,200

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
ILLINOIS (Continued)														
Wireback Oil Co.:														
Plymouth	1,200	1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total§	598,500	627,050	175,780	121,055	267,470	60,640	148,645	162,275	.....	31,145	10,410	4,800	1,880	34,655

*Total feed. †Shell operates a 2,800-bbl. butane isomerization unit at Wood River. ‡Barrels per calendar day. §State totals include crude capacities and calendar-day figures converted to stream-day basis. Cat cracking fresh feed total includes recycle when only total feed is reported.

Indiana

Allby Asphalt & Refining Co.:														
Hammond	9,500	10,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,000
Berry Refining Co.:														
Gary	13,300	14,000	3,600	.....	.....	.....	[1]2,000	[1]2,000	Naphtha	.....	.....	.....	.....	1,600
Cities Service Oil Co. (Del.):														
East Chicago	58,000	58,000	.....	[5]15,000	[1]22,500	7,500	[2]13,000 [7]8,000	.....	.....	[1]2,560	.....	.....	440	.....
Gladieux Refinery, Inc.:														
Fort Wayne	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Indiana Farm Bureau Coop. Association, Inc.:														
Mount Vernon	12,000	12,500	4,000	[2]3,000	[1]3,750	700	[1]3,400	[1]2,100	Mid. dist.	.....	[2]300	.....	.....	.....
Jarvis Refining Co.:														
Troy	1,500	1,550	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Laketon Asphalt Refining, Inc.:														
Laketon	4,000	4,500	4,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000
Mobil Oil Co.:														
East Chicago	36,000	37,800	.....	[1]7,500	[2]15,400	3,900	[1]39,900	[1]13,300	Naphtha	[1]2,600	.....	.....	.....	.....
R. J. Oil & Refining Co., Inc.:														
Princeton	4,000	4,500	.....	[1]1,800	.....	.....	[1]800	.....	.....	.....	.....	.....	.....	.....
Rock Island Refining Corp.:														
Rock Island (Indianapolis)	22,000	24,000	12,000	[2]7,200	[1]7,500	2,000	[1]3,000	[1]5,000 [1]500	Gaso. Naphtha	.....	.....	.....	.....	.....
Sinclair Refining Co.:														
East Chicago	111,000	120,000	47,000	[1]12,000 [2]18,000	[1]36,000	9,000	[7]20,000	[10]3,500	Lube oils	[1]5,000	[2]2,450	2,750	.....	4,000
Standard Oil Co. (Ind.):														
Whiting	215,800	235,000	111,600	[1]25,000 [2]20,000 [5]28,500	[1]83,000	.....	[5]56,000	[3]70,000	Naphtha	[1]5,000	[2]1,000	7,500	1,425	9,900
Total	489,100	523,850	182,200	138,000	168,150	23,100	116,100	96,400	.....	15,160	3,750	10,250	1,865	21,500

Kansas

American Petrofina Co. of Texas:														
El Dorado	19,000	20,000	6,000	.....	[1]6,000	4,000	[1]2,500	.....	.....	.....	[2]450	.....	.....	1,900
Anderson-Prichard Oil Corp.:														
Arkansas City	25,000	26,000	5,000	[1]3,500	[1]7,500	4,800	[1]5,000	.....	.....	[2]2,200	.....	.....	.....	1,300
Century Refining Co., Inc.:														
Shallow Water	4,000	4,200	2,000	[1]1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	400
Cooperative Refinery Association:														
Coffeyville	24,500	25,500	6,000	[5]8,000	[1]10,000	8,500	[1]4,200	[1]2,300	Mid. dist.	[2]1,200	[2]500	1,200	150	1,200
Phillipsburg	13,000	14,000	4,500	.....	[1]5,000	4,500	[1]2,500	[1]3,500	Naphtha	.....	[2]750	.....	.....	1,500

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating: Unit	Hydrogen Treating: Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
KANSAS (Continued)														
Derby Refining Co.:														
Wichita	18,500	20,500	6,000	*[1]3,000	[2]7,500	4,500	[5]2,500	[3]4,000	Naphtha	[2]1,600	*[1]600	.....	.....	2,000
Mid-America Refining Co., Inc.:														
Chanute	2,500	2,625	1,500	[1]1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	350
Mobil Oil Co.:														
Augusta	40,000	42,000	13,200	[1]4,300	[2]14,800	8,000	[1]9,500	.....	.....	[2]1,700	.....	.....	.....	7,000
National Cooperative Refinery Association:														
McPherson	31,000	33,000	.....	[1]2,000 [5]12,000	[1]13,500	6,000	[1]5,000	.....	.....	[2]2,300	[2]1,000	.....	250	.....
Phillips Petroleum Co.:														
Kansas City	70,000	NR	15,000	.....	[1]24,000	16,000	[1]16,000	.....	.....	[2]6,600	.....	2,400	.....	2,400
Skelly Oil Co.:														
El Dorado	45,000	48,000	24,000	[1]6,500 [5]8,500	[1]20,000	2,500	[1]15,000	[1]10,000	Naphtha	[2]3,500	[2]1,400	.....	500	3,000
Standard Oil Co. (Ind.):														
Neodesha	23,100	24,300	.....	[6]5,200	[1]10,000	1,000	[5]6,000	[3]6,000	Naphtha	[1]1,300	.....	.....	90	.....
Vickers Petroleum Co., Inc.:														
Potwin	16,000	17,200	3,000	[1]3,400 [3]1,500	[2]8,200	2,000	[5]3,100	[4]3,000	Naphtha	.....	.....	.....	.....	.....
Total†	331,600	351,005	86,200	60,300	126,500	61,800	71,300	28,800	.....	20,400	4,700	3,600	990	21,050

*Shut down. †State total includes crude capacity not reported, estimated on stream-day basis.

Kentucky

Ashland Oil & Refining Co.:														
Catlettsburg	75,000	80,000	18,000	[1]6,000 [3]2,000	[1]32,000	12,000	[15]6,500	[14]10,000	Naphtha	.....	[2]4,000	.....	.....	7,000
Louisville Refining Co., Inc. (acquired by Ashland Oil & Refining Co.):														
Louisville	10,000	11,000	4,000	[1]2,500	[1]4,000	3,200	[1]2,500	[1]2,500	Naphtha	.....	[2]400	.....	.....	.....
Sohio Petroleum Co.:														
Latonia	16,500	18,000	10,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,000
Somerset Refinery, Inc.:														
Somerset	1,500	1,550	.....	.....	[6]400	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	103,000	110,550	32,000	10,500	36,400	15,200	9,000	12,500	.....	.....	4,400	.....	.....	12,000

Louisiana

Atlas Processing Co.:														
Shreveport*	†17,500	†19,000	.....	‡[3]2,000	.....	.....	[7]7,400	.....	.....	.....	‡[2]500	.....	.....	.....
Bay Petroleum Co., Div. of Tennessee Gas Transmission Co.:														
Chalmette	24,000	26,000	5,000	[2]12,000	[1]9,600	2,400	[1]6,000	.....	.....	.....	[2]900	.....	.....	.....
Bayou State Oil Corp.:														
Hosston	860	1,000	565	.....	.....	.....	.....	.....	.....	.....	.....	480	.....	245
Calumet Refining Co.:														
Princeton	1,800	2,000	2,750	.....	.....	.....	.....	.....	.....	.....	.....	750	.....	400
Canal Refining Co.:														
Church Point	1,700	1,800	.....	.....	.....	.....	[6]750	.....	.....	.....	.....	.....	.....	.....
Cities Service Refining Corp.:														
Lake Charles*	185,000	190,700	32,000	§[2]12,000	[1]88,000	62,000	[2]20,000	.....	.....	[1]17,000	.....	.....	.....	.....

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
LOUISIANA (Continued)														
Continental Oil Co.:														
Westlake (Lake Charles)	53,000	56,000	.....	[1]6,100 [3]4,000 [5]10,000	[2]21,200	7,500	[1]6,800 [16]11,000	[15]11,000	Naphtha	[12]2,800	[1]670 [2]660	.....	325	.....
Cotton Valley Solvent Co.:														
Cotton Valley	¶4,750	¶5,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Esso Standard, Div. of Humble Oil & Refining Co.:														
Baton Rouge	365,000	378,000	130,000	[1]35,000 [2]13,000	[1]141,000	59,000	[2]27,800 [6]32,000	[2]3,600	Solvent	[1]25,000	[2]7,400	10,900	.....	11,000
Evangeline Refining Co., Inc.:														
Jennings	2,000	2,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ingram Oil & Refining Co.:														
Meraux	20,000	21,000	8,000	.....	[1]5,800	1,200	[1]3,800	.....	.....	.....	[2]385	.....	.....	.....
Shell Oil Co.:														
Norco	102,000	107,000	47,000	[1]14,200 [3]4,700	[1]66,000	27,000	[1]18,700	[7]16,800	Naphtha	[1]7,900	[2]1,700	.....	.....	1,840
Total	777,610	810,000	225,315	113,000	331,600	159,100	134,250	31,400	.....	52,700	12,215	12,130	325	13,485

*A 3,730-bbl. pentane and heavier isomerization unit at Atlas' Shreveport plant, and 4,800-bbl. butane isomerization unit at Cities Service's Lake Charles plant. †Basic feed stock is extraction plant gasoline mixed with crude oil. ‡Not operating. §Combination thermal reforming-cracking unit currently being used primarily for visbreaking operations. ¶Fractionates crude and condensate into straightrun products.

Maryland

American Bitumuls & Asphalt Co.:														
Baltimore (Fairfield)	4,500	7,500	7,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,000
American Oil Co.:														
Baltimore	9,000	10,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,000
Esso Standard, Div. of Humble Oil & Refining Co.:														
Baltimore	16,500	19,000	11,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,600
Total	30,000	36,500	18,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20,600

Massachusetts

Esso Standard, Div. of Humble Oil & Refining Co.:														
Everett	50,000	55,000	13,100	.....	[1]20,000	15,000	[5]7,200	[2]7,200	Naphtha	.....	[2]1,800	.....	.....	10,000

Michigan

Aurora Gasoline Co.:														
Detroit	44,000	47,000	34,000	[2]7,000 [4]4,000	[1]17,000	3,000	[2]5,500	[1]10,000	Gas oil	.....	[2]1,400	.....	150	6,500
Muskegon	14,500	16,000	8,000	.....	[1]6,000	3,000	[1]2,400	[1]2,400 [1]1,200	Naphtha Mid. dist.	.....	[2]600	.....	.....	4,000
Bay Refining Corp., Div. of Dow Chemical Co.:														
Bay City	15,000	17,500	5,500	.....	[2]3,600	2,100	.....	.....	.....	[2]750	[2]750	.....	.....	.....
Crystal Refining Co.:														
Carson City	6,700	7,050	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
MICHIGAN (Continued)														
Lakeside Refining Co.:														
Kalamazoo	4,200	4,420			[5]1,500		[7]1,000							
Leonard Refineries, Inc.:														
Alma (Leonard Division)	9,500	10,500	9,000		[1]7,500 [2]5,600	[1]5,500 [2]1,400	[5]2,400	[2]2,400 [2]1,400 [2]3,800	Naphtha Mid. dist. Cat feed	[2]1,100				2,800
Alma (Mid-West Division)	10,000	11,000		[2]3,000			[1]2,200				[2]140			
Mount Pleasant (Roosevelt Division)	7,500	7,700					[1]1,800	[4]500	Naphtha					
Marvel Refining Co.:														
Grand Rapids	1,500	1,500		[3]500										
Mobil Oil Co.:														
Trenton	35,500	37,300		[6]6,500	[6][2]23,000	NR	[1]39,200	[1]39,000	Naphtha	[1]3,700			200	
Naph-Sol Refining Co.:														
Muskegon	10,000	10,200		[2]2,700			[1]1,200				[2]60			
Osceola Refining Co., Inc.:														
Reed City	2,500	2,630												
Petroleum Specialties, Inc.:														
Flat Rock	6,000	6,500					[1]900	[1]1,500	SR naph.					
West Branch Refineries, Inc.:														
West Branch	5,000	5,260					[4]1,150	[6]1,150	Naphtha					
Total†	171,900	184,560	56,500	23,700	64,200	15,000	27,750	33,350		5,550	2,950		350	13,300

[6]Total feed. †Cat cracking fresh feed total includes recycle when only total feed is reported.

Minnesota

Great Northern Oil Co.:														
Pine Bend	33,285	35,000		[5]12,000	[2]16,000	9,000	[5]5,000	[3]5,000 [3]8,500 [2]2,500	Naphtha Mid. dist. Other		[2]1,200		600	
International Refineries, Inc.:														
Wrenshall	14,000	15,000			[1]3,500	1,500	[6]2,800	[2]2,800	Naphtha		[2]270			
Northwestern Refining Co.:														
New Brighton	2,500	2,500												
St. Paul Park	17,000	17,000	10,000		[1]6,500	4,500					[2]500			5,000
Total	66,785	69,500	10,000	12,000	26,000	15,000	7,800	18,800			1,970		600	5,000

Mississippi

Paluxy Asphalt Co.:														
Crupp (Yazoo City)	1,200	1,500												700
Pontiac Eastern Corp.:														
Hattiesburg	10,500	11,500		[4]4,800	[2]9,300	16,300	[1]2,500	[1]1,200	Cat recycle	[1]2,500			225	
Southland Co.:														
Sandersville	4,500	5,500	2,500											2,500
Total	16,200	18,500	2,500	4,800	9,300	16,300	2,500	1,200		2,500			225	3,200

Missouri

Standard Oil Co. (Ind.):														
Sugar Creek	76,100	78,500	7,200	[1]12,280 [2]2,900 [5]14,300	[1]35,500	2,000	[5]14,000	[3]20,000	Naphtha	[1]3,800	[2]2,200		400	3,000

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Montana														
Big West Oil Co. of Montana:														
Kevin	2,700	3,000	700	*[8]1,250	.....	.....	[1]1,000	[1]1,250	Naphtha	.....	[2]20	.....	.....	225
Carter Division, Humble Oil & Refining Co.:														
Billings	34,000	40,000	10,000	[4]4,200	[1]16,500	10,500	[5]2,500	[2]7,000 [2]10,500	Mid. dist. Naphtha	[2]2,300	[2]2,400	.....	200	7,800
Continental Oil Co.:														
Billings	10,300	12,000	.....	.....	[1]5,500	6,200	[1]62,500	[1]3,000 [1]3,600 [1]900	Naphtha Mid. dist. Other	.....	[2]500	.....	.....	1,400
Diamond Asphalt Co.:														
Chinook	1,415	1,500	700	.....	.....	.....	[1]200	[1]200	SR gaso.	.....	.....	.....	.....	550
Farmers Union Central Exchange:														
Laurel	19,000	20,000	13,000	[6]6,000	[1]8,000	2,000	[1]4,450	[1]5,350 [1]7,100	Naphtha Mid. dist.	.....	[2]2,000	.....	.....	4,000
Jet Fuel Refinery Co.:														
Mosby	1,500	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phillips Petroleum Co.:														
Great Falls	3,800	NR	1,600	.....	[1]1,200	1,800	.....	.....	.....	.....	[2]50	.....	.....	525
Texaco Inc:														
Sunburst	8,000	NR	.....	‡[5]5,000	.....	.....	.....	.....	.....	.....	‡[2]100	.....	.....	.....
Union Oil Co. of California:														
Cut Bank	3,800	4,200	.....	[1]400 [2]2,300	.....	.....	[7]600	[1]900	Mid. dist.	.....	[2]75	.....	.....	.....
Unity Petroleum Corp.:														
Kalispell	1,000	1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	500
Total‡	85,515	95,820	26,000	19,705	31,200	20,500	11,250	39,800	.....	2,300	5,155	.....	200	14,975
Nebraska														
Cooperative Refinery Association:														
Scottsbluff	2,800	3,000	.....	[1]1,100	.....	.....	[1]650	.....	.....	.....	.....	.....	.....	.....
New Jersey														
California Oil Co.:														
Perth Amboy	115,500	123,000	65,000	[5]5,000	[3]29,000	2,000	[1]21,000	[1]10,000	Mid. dist.	[1]2,500	[2]400	.....	.....	5,500
Cities Service Oil Co. (Pa.):														
Linden	14,300	15,000	10,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,900
Esso Standard, Div. of Humble Oil & Refining Co.:														
Bayonne	25,000	28,500	15,000	.....	.....	.....	.....	*[2]3,600	Wax	.....	.....	.....	.....	10,200
Linden (Bayway refinery)	168,000	175,000	73,800	[3]8,000 [10]8,500	[1]73,000	29,000	[8]20,000	[2]20,000 [2]30,000 [2]15,000	Naphtha Mid. dist. Other	[1]10,700	[2]3,600	.....	.....	.....
Hess Trading & Transport, Inc.:														
Sewaren	71,250	75,000	.....	.....	.....	.....	[1]4,000	[1]5,000 [1]5,000	Naphtha Mid. dist.	.....	.....	.....	.....	.....
Mobil Oil Co.:														
Paulsboro	87,000	91,400	41,000	[5]8,890	[†2]40,550	NR	[1]21,800	[1]21,800 [1]26,890	Naphtha Mid. dist.	[2]2,400	.....	8,000	800	.....
Petroleum Separating Co. (Metropolitan Petroleum Corp.):														

*Charges topped crude. †Barrels per calendar day. ‡State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
NEW JERSEY (Continued)														
Bayonne‡	19,000	20,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Texaco Inc.:														
Westville	73,000	NR	§25,000	§[2]12,000 §[3]9,000	§[1]35,000	.....	§[1]12,000	§[1]12,000 §[4]6,000	SR naph. Cat. dist.	§[1]2,300	§[2]2,500	.....	.....	.....
Total¶	573,050	604,740	231,115	63,725	181,440	31,000	80,135	157,290	.....	18,155	6,780	8,000	800	24,600

*Fixed bed nickel catalyst. †Total feed. ‡A bonded operation, processing for the account of others. §Barrels per calendar day. ¶State totals include crude capacities not reported and calendar-day figures converted to stream-day basis. Cat cracking fresh feet total includes recycle when only total feed is reported.

New Mexico

Continental Oil Co.:														
Artesia*	15,500	16,400	2,500	[1]1,875	[2]6,000	1,400	[4]1,500	[14]1,450 [14]250	Naphtha SR gaso.	[2]1,000	.....	.....	.....	2,100
El Paso Natural Gas Products Co.:														
Bloomfield	1,000	1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ciniza (Gallup)	8,100	9,000	3,400	.....	[1]2,850	2,500	[1]1,800	.....	.....	[1]1,000	.....	.....	.....	.....
Famariss Oil & Refining Co.:														
Monument	1,380	1,400	.....	.....	.....	.....	[1]650	[1]800	Naphtha	.....	.....	.....	.....	.....
Four States Western Oil Refining Co.:														
Flora Vista (Farmington)	2,000	2,100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	27,980	29,900	5,900	1,875	8,850	3,900	3,950	2,500	.....	2,000	.....	.....	.....	2,100

*This includes Hondo Oil & Gas Co. facilities (formerly Malco Refineries, Inc.) which have been leased by Continental.

New York

Ashland Oil & Refining Co.:														
North Tonawanda	29,000	30,000	15,000	.....	[1]11,000	4,500	[15]7,500	[14]10,000	Naphtha	.....	[2]1,000	.....	.....	3,000
Mobil Oil Co.:														
Brooklyn	30,500	32,000	.....	.....	[2]14,800	8,000	.....	.....	.....	.....	[2]1,200	.....	.....	.....
Buffalo	29,500	31,050	6,300	.....	*[2]21,440	NR	[13]8,900	[13]8,900	Naphtha	[1]3,000	†1,000	.....	.....	2,300
Total‡	89,000	93,050	21,300	.....	47,240	12,500	16,400	18,900	.....	3,000	3,200	.....	.....	5,300

*Total feed. †Idle. ‡State total for cat cracking fresh feed includes recycle when only total feed is reported.

North Dakota

Standard Oil Co. (Ind.):														
Mandan	40,900	43,000	.....	.....	[1]18,000	7,000	[5]6,000	.....	.....	[2]1,800	[2]1,440	.....	.....	.....
Westland Oil Co.:														
Williston	2,300	3,000	.....	[1]1,000	.....	.....	[1]700	.....	.....	.....	.....	.....	.....	.....
Total	43,200	46,000	.....	1,000	18,000	7,000	6,700	.....	.....	1,800	1,440	.....	.....	.....

Ohio

American Bitumuls & Asphalt Co.:														
Cincinnati	6,500	12,000	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9,000
Ashland Oil & Refining Co.:														
Canton	34,000	35,000	20,000	[2]5,000	[1]12,000	5,000	[15]7,500	[14]10,000	Naphtha	.....	[2]1,200	.....	.....	3,600

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
OHIO (Continued)														
Gulf Oil Corp.:														
Cincinnati	35,320	37,000	7,000	[1]6,500	[1]13,300	5,700	[1]10,000	.....	.....	.....	[2]1,500	.....	.....	2,600
Toledo	43,000	45,000	8,200	[1]2,250 [2]2,920	[1]15,500	3,500	[1]10,000	.....	.....	[1]1,500	[2]1,300	.....	.....	.....
Midwest Refining Co.:														
Weston	500	500	500	.....	.....	.....	.....	.....	.....	.....	.....	300	.....	.....
Pure Oil Co.:														
Newark	19,000	NR	6,100	[1]6,400	[1]6,500	.....	[2]3,000	[1]13,000	Naphtha	.....	[2]450	.....	.....	.....
Toledo	38,400	NR	4,400	[1-2]5,100 [5]7,000	[1]11,600	7,400	[3]5,000	.....	.....	.....	[2]1,270	.....	150	.....
Standard Oil Co. (Ohio):														
Cleveland	52,000	55,000	18,000	[1]12,000	[2]20,000	13,000	[5]11,000	[3]11,000	Naphtha	[1]3,500	[2]1,000	1,600	.....	5,000
Lima	48,000	50,000	11,000	[5]11,000	[1]29,600	15,400	[1]12,000	[1]12,000 [1]1,000	Naphtha Mid. dist.	.....	[2]800	1,700	320	.....
Toledo	54,000	60,000	.....	[5]7,500	[1]30,000	36,000	[7]12,000	[15]12,000 [15]10,500	Naphtha Other	[1]5,900	[2]2,350	.....	320	.....
Sun Oil Co.:														
Toledo	95,000	NR	.....	*[3]17,000	*†[3]62,000	.....	*[1]14,700	.....	.....	*[1]1,400	*[2]3,000	.....	.....	.....
Total‡	425,720	454,920	87,200	84,560	207,390	86,000	86,835	59,500	.....	12,455	13,205	3,600	790	20,200

*Barrels per calendar days. †Total feed. ‡State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Oklahoma

Allied Materials Corp.:														
Stroud	3,000	3,400	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000
Anderson-Prichard Oil Corp.:														
Cyril	12,000	12,500	5,000	[1]1,900	[1]6,000	2,000	[6]1,000	[1]1,000	Naphtha	.....	[2]600	.....	.....	1,200
Bell Oil & Gas Co.:														
Grandfield*	7,200	8,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ben Franklin Refining Co.:														
Ardmore	11,000	12,000	6,500	[1]2,000	[1]8,500	4,500	.....	.....	.....	[2]1,100	[2]250	.....	.....	2,200
Champlin Oil & Refining Co.:														
Enid	31,680	33,000	12,000	[1]4,000 [2]4,000	[1]11,000	5,000	[1]5,000	.....	.....	[2]1,500	[2]1,000	1,500	.....	1,500
Cities Service Oil Co. (Del.):														
Ponca City	35,000	37,500	10,500	[1]2,500	[1]14,000	9,200	[2]6,000	.....	.....	.....	.....	.....	.....	.....
Continental Oil Co.:														
Ponca City	72,000	77,000	10,800	[1]6,500 [3]4,000 [5]15,100	[4]25,200	11,000	[1]5,100 [16]11,000	[14]16,000	Naphtha	[2]5,000	[2]750	2,250	485	.....
DX Sunray Oil Co.:														
Duncan	44,000	45,000	16,000	[5]11,000	[1]25,000	12,500	[1]6,000	[1]6,000	SR naph.	[2]3,500	[2]750	.....	400	.....
Tulsa†	74,000	75,000	24,000	[5]8,500	[1]29,000	6,000	[1]19,500	[1]20,000	SR naph.	[1]2,300 [2]2,500	[2]2,000	6,500	300	.....
Kerr-McGee Oil Industries, Inc.:														
Cushing	21,500	22,000	3,900	[2]7,200	[1]7,600	3,200	‡[1]2,200	.....	.....	.....	[2]400	900	.....	400
Wynnewood	24,000	25,000	10,000	.....	[1]8,500	4,500	[1]5,500	[1]4,000 [15]5,500	Gas oil Naphtha	.....	[2]500	.....	.....	2,750
Midland Cooperatives, Inc.:														
Cushing	12,300	13,000	.....	[2]6,000	[1]5,300	3,700	[1]2,580	.....	.....	.....	§[2]450	.....	.....	.....

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating: Unit	Hydrogen Treating: Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
OKLAHOMA (Continued)														
Phillips Petroleum Co.:														
Okmulgee	19,000	NR	8,000	.....	[1]7,000	3,000	.....	.....	.....	.....	[2]700	.....	.....	450
Texaco Inc.:														
West Tulsa†	40,000	NR	¶12,000	¶[1]9,000 ¶[3]5,000	¶[1]15,000	.....	¶[1]8,000	¶[1]8,000	SR naph.	¶[1]2,300	¶[2]1,500	.....	.....	.....
Total‖	406,680	425,505	121,330	88,255	163,765	64,600	72,770	61,390	.....	18,455	9,065	11,150	1,185	10,500

*Shut-down facilities include a 3,500-bbl. thermal cracker for residuum, a 1,900-bbl. Platformer, and a 150-bbl. catalytic polymerization unit. †Butane isomerization facilities include a 2,400-b.p.s.d. unit at the DX Sunray Tulsa plant, and a 500-b.p.c.d. unit at Texaco's West Tulsa plant. ‡Platformer is located at Cleveland, Okla. §To be shut down on startup of alkylation unit in April 1960. ¶Barrels per calendar day. ‖State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Oregon

American Bitumuls & Asphalt Co.:														
Portland (Willbridge)	3,800	7,000	7,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,500

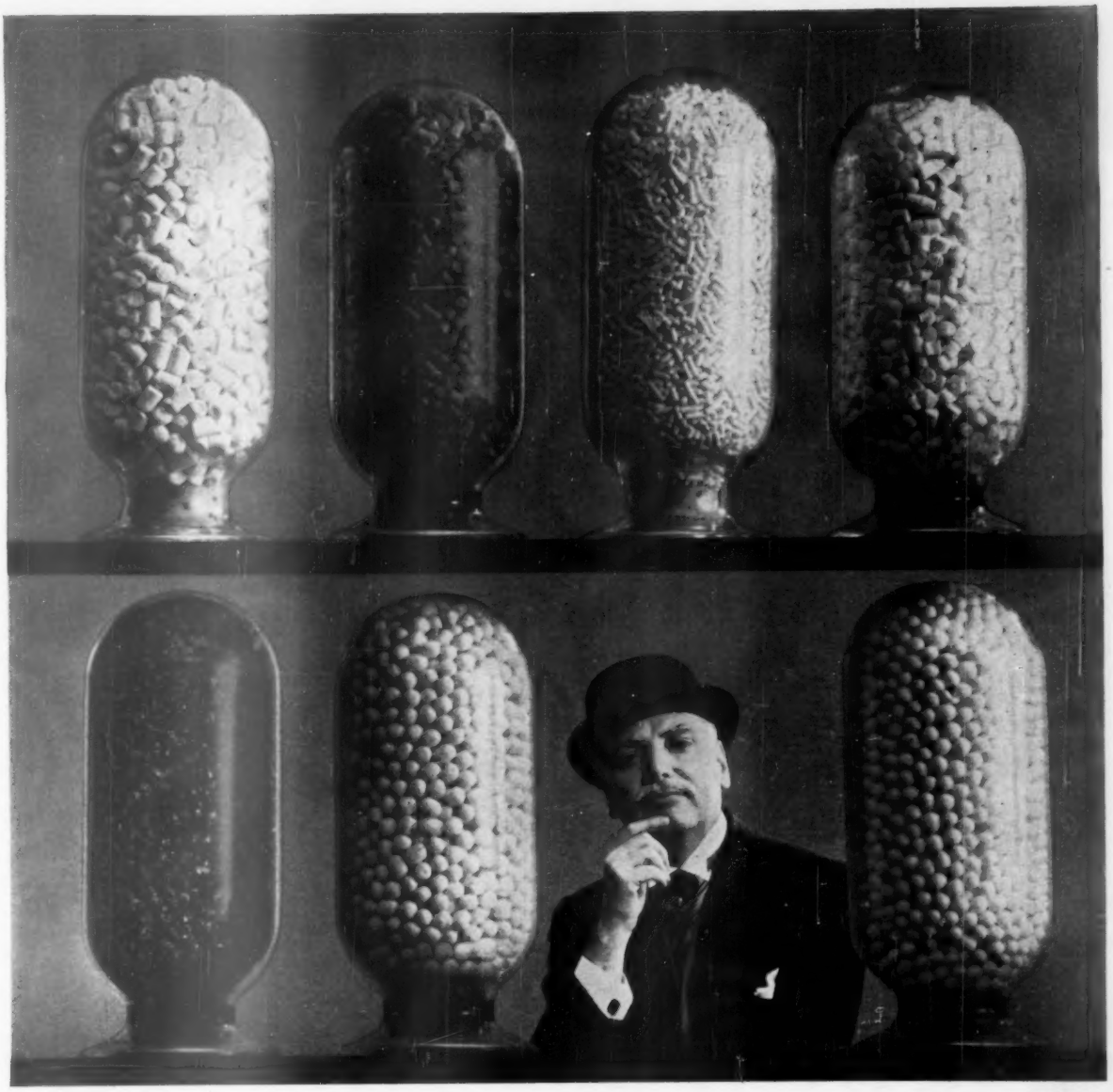
Pennsylvania

Atlantic Refining Co.:														
Philadelphia	148,000	156,000	60,000	[2]20,000	[1]51,200	22,000	[6]29,000	[1]15,000	Naphtha	*[1]5,400	*[2]1,700	*5,000	.....	*7,500
Franklin Refinery, Div. of Sonneborn Chemical & Refining Corp.:														
Franklin	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	500	.....	.....
Gulf Oil Corp.:														
Philadelphia	182,000	192,000	82,000	[2]24,000 [3]8,000	[1]61,200	28,800	[1]68,000	[5]50,000 [16]52,000	Mid. dist. Naphtha	[1]6,800	[2]3,600	.....	.....	.....
Kendall Refining Co.:														
Bradford	4,800	5,200	.....	.....	.....	.....	[1]1,500	[1]2,000	Naphtha	.....	.....	1,200	.....	.....
Pennsylvania Refining Co.:														
Karns City	1,500	1,580	600	.....	.....	.....	.....	.....	.....	.....	.....	500	.....	.....
Pennzoil Div., South Penn Oil Co.:														
Rouseville	10,000	10,400	.....	.....	[1]3,600	360	[1]2,900	[1]3,650	SR	.....	[2]380	2,500	.....	.....
Quaker State Oil Refining Corp.:														
Emlenton	2,540	3,000	1,500	[1]750 [3]600	.....	.....	[1]1,000	.....	.....	.....	[2]75	1,700	.....	.....
Farmers Valley	3,810	4,500	.....	[1]1,350	.....	.....	[1]1,500	.....	.....	.....	[2]100	2,300	.....	.....
Sinclair Refining Co.:														
Marcus Hook	133,000	140,000	71,000	[1]5,000 [2]27,000	[1]40,000	10,000	[7]22,000	[10]22,000 [10]10,000	Naphtha Mid. dist.	.....	[2]1,850	.....	.....	.....
Sun Oil Co.:														
Marcus Hook	160,000	NR	.....	*[2]14,600 *[3]24,000	*†[2]23,000 *†[3]33,000 *†[4]23,000	.....	*[4]32,000	*[14]15,000	Mid. dist.	*[2]7,000	.....	*11,800	.....	*800
United Refining Co.:														
Warren	15,000	15,600	4,500	.....	[1]5,000	1,500	[7]4,000	[1]5,500 [1]1,200	Naphtha Mid. dist.	.....	[2]350	.....	.....	1,000
Valvoline Oil Co., Div. of Ashland Oil & Refining Co.:														
Freedom	5,500	6,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	800	.....	.....
Wolf's Head Oil Refining Co., Inc.:														
Reno	2,150	2,350	.....	.....	.....	.....	.....	.....	.....	.....	.....	480	.....	.....
Total‡	670,300	707,050	221,600	129,590	248,780	62,660	165,455	178,015	.....	20,580	8,245	28,645	.....	10,225

*Barrels per calendar day. †Total feed. ‡State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Rhode Island														
Mobil Oil Co.:														
East Providence	11,200	11,790	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,000
Texaco Inc.:														
Providence	3,500	NR	*1,750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*1,500
Total†	14,700	15,475	1,840	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,665
South Carolina														
Esso Standard, Div. of Humble Oil & Refining Co.:														
Charleston	11,440	13,000	10,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,949
Tennessee														
Delta Refining Co.:														
Memphis	18,500	20,000	6,500	.....	[2]7,000	2,000	.....	.....	.....	[2]1,200	[2]500	.....	.....	3,000
Texas														
American Oil Co.:														
Texas City	[1]48,000	160,000	33,000	[1]28,000 [2]14,000 [9]9,800	[1]64,000	4,000	[5]42,000	[3]42,000	Naphtha	[1]9,000	[2]3,000	.....	.....	5,000
American Petrofina Co. of Texas:														
Mount Pleasant	19,000	20,000	12,000	.....	[2]6,200	3,800	[1]3,000	.....	.....	[2]1,500	*[2]550	.....	.....	5,200
Wichita Falls	9,000	10,000	.....	[1]2,600	[1]2,800	800	[1]3,000	.....	.....	.....	[2]250	.....	.....	.....
Anderson Refining Corp.:														
Tucker	2,500	2,630	.....	[1]1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Atlantic Refining Co.:														
Port Arthur	62,000	65,000	19,000	.....	[1]21,700	9,300	[6]23,000	[1]15,000	Naphtha	†[1]2,100	†[2]150	.....	.....	.....
Bryson Pipeline & Refining Co.:														
Bryson	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	190	.....	.....
Cactus Petroleum Co., Inc.:														
La Blanca	3,000	5,000	.....	.....	.....	.....	[6]750	.....	.....	.....	.....	.....	.....	.....
Col-Tex Refining Co.:														
Colorado City	12,500	13,000	8,000	[1]3,700	.....	.....	[1]2,000	[1]2,800	Naphtha	.....	[2]100	.....	.....	3,200
Continental Oil Co.:														
Wichita Falls	10,800	12,000	.....	[1]5,500	.....	.....	[16]3,500	.....	.....	.....	[2]200	.....	.....	.....
Cosden Petroleum Corp.:														
Big Spring	29,600	30,500	14,850	[1]5,000 [2]3,000	[1]14,000	3,000	[1]4,500 [9]5,500	[1]8,000 [1]1,000	Naphtha Mid. dist.	[2]4,000	[2]1,000	.....	.....	3,900
Crown Central Petroleum Corp.:														
Houston	40,000	NR	.....	[1]8,500	[2]12,000	4,000	[4]5,500	[6]5,500	Naphtha	.....	.....	.....	.....	.....
Danaho Refining Co.:														
Pettus	11,400	12,000	.....	[1]1,000	.....	.....	[1]1,000	.....	.....	.....	[2]50	.....	.....	.....
Delhi-Taylor Oil Corp.:														
Corpus Christi	40,000	42,000	.....	[2]2,400	[2]12,000	3,000	[1]15,000	[1]14,000 [1]1,000	Naphtha Other	.....	[2]500	.....	.....	.....
Delhi-Taylor Oil Corp. and Mayfair Minerals, Inc.:														
Port Isabel	15,000	15,800	.....	.....	.....	.....	[1]4,000	.....	.....	.....	.....	.....	.....	.....

*Barrels per calendar day. †State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.



COMPLETE CATALYST SERVICE (BRAINPOWER INCLUDED)

Looking at catalyst samples won't usually show you why one may be better than another of the same general type. Look at plant operating figures, though, and you may see a different story.

That's why getting the right catalyst—for your process, for your plant—usually involves much more than simply buying "off the shelf." Houdry's catalyst service staff has the facts to prove it.

Over and over again, Houdry's process experience has been a major factor in helping processors select the right catalyst, and in helping to get maximum usefulness from it. Process experience is also especially valuable when a custom catalyst must be designed and manufactured.

Houdry's catalyst service is based on more than 30 years of commercial experience in process design and operation and catalyst development and manufacture. This service is Houdry's way of putting "brainpower" into the "package", to help you get the results you want when you select any of Houdry's wide range of catalysts.

It's a good idea to get in touch with Houdry on *any* catalyst problem. There's a good chance that, in solving problems for others, Houdry may have already found the solution for yours.

*HOUDRY

PROCESS CORPORATION

1528 Walnut Street, Philadelphia 2, Pa.

*Houdry means Progress...through Catalysis

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
TEXAS (Continued)														
Eastern States Petroleum & Chemical Corp.:														
Houston	63,000	65,000	25,000	[2]20,000	[1]20,000	3,400	[1]12,500	[1]17,000 [1]12,000 [1]6,000	Naphtha Mid. dist. Other	[1]5,000	.....	.....	.....	.....
Eddy Refining Co.:														
Houston	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
El Paso Natural Gas Products Co.:														
Odessa	11,700	13,000	4,650	.....	[1]3,900	2,350	[1]2,600	.....	.....	[1]1,700	.....	.....	.....	.....
Flint Chemical Co.:														
San Antonio	800	800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gratex Corp.:														
Graham	500	500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Great Western Producers, Inc.:														
Irving	2,200	2,300	.....	.....	.....	.....	[7]1,200	.....	.....	.....	.....	.....	.....	.....
Gulf Oil Corp.:														
Port Arthur‡	271,920	287,000	129,500	[1]2,500 [2]23,500 [3]20,500	[1]102,000	23,000	[1]67,000	[5]50,000 [10]67,000	Mid. dist. Naphtha	[1]8,500	[2]6,000	13,000	.....	.....
Howell Refining Co.:														
Corpus Christi	4,750	5,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Antonio	2,850	3,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Humble Oil & Refining Co.:														
Baytown	292,300	309,000	157,100	.....	[1]141,400	26,600	[5]46,000	[2]42,000 [2]6,000 [2]9,800 [2]18,000	Mid. dist. Solv. dist. Lube-oil dist. Hvy. cr. naph.	[1]17,000	[2]5,700	19,700	.....	11,200
La Gloria Oil & Gas Co.:														
Tyler	24,000	25,000	.....	[1]3,000 [5]8,500	[1]10,000	5,000	[1]5,000	.....	.....	[1]2,400	.....	.....	75	.....
Mobil Oil Co.:														
Beaumont	220,000	237,000	49,000	[2]56,500 [3][10]10,000	[2]80,000	20,000	[13]24,000	[13]33,335	Naphtha	[1]14,300	.....	6,400	.....	.....
Monarch Refining Co.:														
San Antonio	4,000	4,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Petroleum Refining Co.:														
Lueders	2,500	2,630	.....	[1]700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phillips Petroleum Co.:														
Phillips	71,000	NR	17,000	[2]4,500	[1]38,000 [5]11,000	2,000	[1]16,000	[14]10,000	Mid. dist.	[2]8,500	[2]750	.....	.....	.....
Sweeny	95,000	NR	17,000	.....	[1]24,000	6,000	[1]32,000	.....	.....	[2]5,000	.....	.....	.....	.....
Pontiac Refining Corp.:														
Corpus Christi	42,750	45,000	7,500	.....	[1]7,400	3,000	[1]12,500	[1]6,000	Naphtha	.....	[2]500	.....	.....	.....
Premier Oil Refining Co. of Texas, Div. of Western Natural Gas Co.:														
Baird	2,350	2,500	.....	[1]1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brownsville	5,300	5,500	5,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,200
Fort Worth	7,900	8,000	1,700	[8]2,200	[1]3,000	2,700	[1]1,700	.....	.....	.....	[2]290	.....	.....	.....
Longview	5,800	6,000	.....	[1]3,000	.....	.....	[1]1,500	[1]1,500	Naphtha	.....	[2]90	.....	.....	.....
Pure Oil Co.:														
Nederland	78,900	NR	20,000	[1]10,500	[1]20,000 [2]17,100	7,500 2,900	[5]15,000	[15]15,000 [15]5,000	Naphtha SR gaso.	[1]2,850	[2]825	2,000	.....	.....
Rado Refining Co.:														
McAllen	1,500	1,500	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

what's your best estimate?

. . . a quiz for refinery men who want to keep posted

QUESTION 1. In these countries in the sterling area—England, Scotland, Ireland and India—how many new oil refineries have been built since the close of World War II?

a 4

b 6

c 8

d 12

QUESTION 2. How many of these refineries have been designed, engineered and constructed by Lummus?

a 3

b 5

c 7

d 9

ANSWERS: 1. *The answer is* (d)—*12 new refineries since the war, according to* World Petroleum *magazine.*

2. *Here* (b) *is correct. Lummus has built 5, or 42%, of the new refineries in these countries since World War II, through the Lummus Company Ltd. of London. These five refineries are for Vacuum Oil Company Limited at Corylon, England; California Texas Oil Corporation at Vizakhapnam, India; Burmah-Shell Refineries, Ltd. at Bombay, India; Standard-Vacuum Oil Company, Ltd. at Bombay, India; and the Irish Refining Company, Ltd. at Whitegate, Ireland. Lummus Ltd. maintains a staff of over 400 specialists, and has engineered and constructed hundreds of process plants of all types and sizes in the sterling area from India to Ireland. Lummus Ltd. is one of seven international members of the Lummus group of companies which circles the globe. See Lummus on your next project.*

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Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating: Unit	Hydrogen Treating: Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
TEXAS (Continued)														
Republic Oil Refining Co.:														
Texas City	42,750	45,000	16,000	.....	[1]20,000	6,000	[1]7,500	.....	.....	[1]1,500	[1]1,800	.....	.....	.....
Shamrock Oil & Gas Corp.:														
Sunray‡	23,750	25,000	11,500	[1]3,000	[3]11,000	2,000	[1]2,500	[1]2,500 [1]3,000	Naphtha Jet fuel	[2]3,200	.....	.....	.....	550
Shell Oil Co.:														
Houston	128,000	132,000	60,400	[1]25,500 [3]10,000	[1]43,000	7,000	[1]31,400	[7]18,200	Naphtha	[1]6,000	.....	4,400	.....	1,700
Sinclair Refining Co.:														
Corpus Christi	29,000	31,000	.....	[1]7,000 [2]3,000	[4]12,000	3,000	[7]7,500	[10]7,500	Naphtha	[2]1,870	.....	.....	.....	.....
Houston	138,000	150,000	43,000	[1]10,000 [2]14,000	[1]50,000 [2]10,000	33,335 1,100	[7]30,000	[10]30,000 [10]35,000	Naphtha Mid. dist.	[1]3,500	.....	4,850	.....	.....
Skelly Oil Co.:														
Longview	4,500	5,000	.....	[1]3,300	.....	.....	[1]1,500	[1]4,000	Naphtha	.....	[2]100	.....	.....	.....
Southwestern Oil & Refining Co.:														
Corpus Christi	33,000	37,000	9,000	.....	[1]8,700	2,500	[1]10,000	.....	.....	.....	[2]700	.....	.....	1,000
Standard Oil Co. of Texas:														
El Paso	75,000	82,000	24,600	[9]9,000	[1]13,500 [3]11,000	13,500 4,000	[1]5,500	.....	.....	[1]1,600	[2]2,025	.....	.....	.....
Suntide Refining Co.:														
Corpus Christi	62,300	65,000	13,000	.....	[1]18,500	14,000	[1]11,000	[1]6,000	Naphtha	[2]2,200	[2]450	.....	.....	.....
Texaco Inc.:														
Amarillo	19,000	NR	.....	†[1]2,000 †[3]3,500	†[1]8,000	.....	†[1]4,500	†[1]4,500	SR naph.	†[1]800	†[2]400	.....	†100	.....
El Paso	16,000	NR	.....	†[1]2,000 †[3]3,500	†[1]7,000	.....	†[1]3,500	†[1]3,500	SR naph.	†[1]1,500	†[2]500	.....	†100	.....
Port Arthur	280,000	NR	†100,000	†[1]70,000 †[3]17,500 †[5]7,000	†[1]120,000	.....	†[1]60,000	†[1]60,000	SR naph.	†[1]13,800	†[2]1,800	†17,000	†200	.....
Port Neches	40,000	NR	†22,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	†9,000
Texas City Refining, Inc.:														
Texas City	34,000	35,000	11,500	[2]5,000	[3]16,000	1,600	[4]7,000	[4]7,000	Naphtha	[2]2,700	.....	.....	.....	.....
Texas Gas Corp.:														
Winnie	6,800	7,000	.....	.....	.....	.....	[1]3,000	.....	.....	.....	.....	.....	.....	.....
Texstar Petroleum Co. (formerly Texas-Calgary Co.):														
Carrizo Springs	2,500	2,800	.....	[1]500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Three Rivers Refinery:														
Three Rivers	1,500	1,500	500	.....	.....	.....	.....	.....	.....	.....	.....	750	.....	150
Tydal Co.:														
Gainesville	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	200	.....	.....
Waskom Natural Gas Corp.:														
Waskom	2,500	2,500	.....	.....	.....	.....	[7]1,000	.....	.....	.....	.....	.....	.....	.....
Wickett Refining Co.:														
Wickett	3,500	3,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total¶	2,561,920	2,714,535	840,215	458,820	974,195	220,385	543,205	576,690		122,545	28,045	70,380	515	45,100

*Standby capacity. †Barrels per calendar day. ‡4,900-bbl. pentane and higher isomerization unit at Gulf's Port Arthur plant, and 1,800-bbl. butane isomerization unit at Shamrock's Sunray plant. §Idle. ¶State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Utah														
Petroflex Corp. (formerly Sure Seal Corp.):														
Woods Cross	700	700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phillips Petroleum Co.:														
Woods Cross	13,500	NR	3,000	.....	[2]5,500	4,500	[1]3,600	.....	.....	.....	[2]400	.....	.....	1,350
Salt Lake Refining Co.:														
Salt Lake City	43,000	45,000	27,000	.....	[7]7,000 [8]8,000	[2]2,000 [5]5,000	[6]6,000	.....	.....	.....	.....	.....	.....	.....
Utah Oil Refining Co.:														
Salt Lake City*	35,000	35,700	.....	[7]7,000	[1]17,400	.....	[5]5,500	.....	.....	[5]5,000	[2]700	.....	.....	1,500
Western States Refining Co.:														
North Salt Lake City	7,500	7,500	.....	[1]1,500	.....	.....	[4]1,000	[6]1,000	Naphtha	.....	.....	.....	.....	.....
Total	99,700	103,110	30,000	8,500	37,900	11,500	16,100	1,000	.....	5,000	1,100	.....	.....	2,850

*Includes 1,000-bbl. butane isomerization unit.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Virginia														
American Oil Co.:														
Yorktown	36,800	38,000	21,000	[5]14,000	[1]22,000	9,000	[5]7,600	[3]7,600 [3]15,000	Naphtha Mid. dist.	.....	[2]2,500	.....	700	.....
Washington														
American Bitumuls & Asphalt Co.:														
Richmond Beach	1,000	3,500	3,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,600
Mobil Oil Co.:														
Ferndale	35,000	37,000	10,000	[2]6,600	[2]14,800	8,200	[1]9,555	[1]6,670	Naphtha	.....	[2]1,300	.....	.....	.....
Shell Oil Co.:														
Anacortes	55,000	58,000	25,000	.....	[1]25,000	12,500	[1]8,500	[7]10,000	Naphtha	[1]3,800	[2]4,100	.....	.....	.....
Texas Inc.:														
Anacortes	45,000	NR	*18,000	.....	*[1]25,000	.....	*[1]8,000	*[4]20,000	SR naph.	*[1]2,300	*[2]1,100	.....	.....	.....
Union Oil Co. of California:														
Edmonds	4,000	4,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,100
U. S. Oil & Refining Co.:														
Tacoma	12,500	14,000	2,500	[1]2,300	.....	.....	[4]3,000	[1]3,000	Naphtha	.....	[2]100	.....	.....	2,000
Total†	152,500	164,370	59,945	8,900	67,575	20,700	29,945	41,890	.....	6,355	6,720	.....	.....	7,700

*Barrels per calendar day. †State totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
West Virginia														
Elk Refining Co.:														
Falling Rock	4,200	4,500	2,000	[1]800	.....	.....	[1]1,500	[1]2,000 [1]500	Naphtha Mid. dist.	.....	[2]80	1,000	.....	.....
Quaker State Oil Refining Co.:														
St. Marys	2,370	2,800	.....	[1]750 [3]600	.....	.....	[1]1,000	.....	.....	.....	[2]75	600	.....	.....
Total	6,870	7,000	2,000	2,150	.....	.....	2,500	2,500	.....	.....	155	1,600	.....	.....

Company, and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking Fresh Feed	Catalytic Cracking Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
Wisconsin														
Empire Petroleum Co.:														
Sheboygan	5,000	5,500	4,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,200
Lake Superior Refining Co.:														
Lake Superior	14,250	15,000	3,000	[1]1,500	.....	.....	[1]3,300	2,700 [2]2,500	Naphtha Mid. dist.	.....	.....	.....	.....	1,500
Total	19,250	20,500	7,000	1,500	.....	.....	3,300	5,200	.....	.....	.....	.....	.....	3,700
Wyoming														
C & H Refinery:														
Lusk	200	200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Empire State Oil Co.:														
Thermopolis	4,750	5,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Frontier Refining Co.:														
Cheyenne	20,500	21,000	9,000	[1]1,000	[1]9,000	1,500	[2]2,500	[1]1,700 [1]1,800	Mid. dist. Cat recyc.	.....	[2]800	.....	.....	2,400
Husky Hi-Power, Inc.:														
Cody	6,500	7,200	3,600	.....	.....	.....	[6]1,000	[1]1,000	SR dist.	.....	.....	.....	.....	2,500
Mobil Oil Co.:														
Casper	12,500	13,100	.....	[1]1,700	*[2]11,670	NR	[13]3,300	[13]3,300 [13]3,000	Naphtha Mid. dist.	.....	[2]500	.....	.....	1,500
Sinclair Refining Co.:														
Sinclair	24,000	26,000	9,000	[2]2,000 [3]2,000	[1]10,000	2,500	.....	.....	.....	[1]1,870	[2]350	.....	.....	1,000
Sioux Oil Co.:														
Newcastle	5,500	6,000	.....	[1]3,000	.....	.....	[4]750	.....	.....	.....	[2]80	.....	.....	.....
Standard Oil Co. (Ind.):														
Casper	17,000	21,000	11,800	[1]4,800 [6]2,500	[1]8,900	600	[5]3,750	[3]5,000	Naphtha	[1]720	.....	840	83	3,000
Texaco Inc.:														
Casper	17,000	NR	†9,000	†[1]4,000	†[1]6,000	.....	†[1]4,000	†[1]4,000	Naphtha	.....	†[2]500	.....	†100	†1,500
Total‡	107,950	117,395	42,875	21,445	46,235	4,600	15,745	20,245	.....	2,590	2,285	840	193	12,065
Puerto Rico														
Caribbean Refining Co.:														
Bayamon	14,400	15,000	9,600	.....	[1]8,500	4,600	.....	.....	.....	.....	[2]460	.....	.....	.....
Commonwealth Oil Refining Co., Inc.:														
Guayanilla Bay	75,000	79,500	49,600	[2]20,000	[4]34,000	19,000	[4]7,460	[1]3,500 [1]6,500	Mid. dist. Cat. recyc.	[1]1,700	[2]2,370	.....	.....	.....
Total	89,400	94,500	59,200	20,000	42,500	23,600	7,460	10,000	.....	1,700	2,830	.....	.....	.....

*Total feed. †Barrels per calendar day. ‡State totals include crude capacities not reported and calendar-day figures converted to stream-day basis. Cat cracking fresh feed total includes recycle when only total feed is reported.

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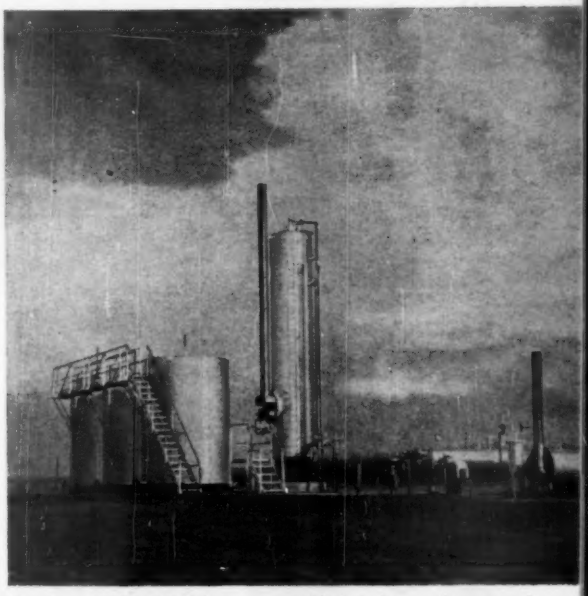

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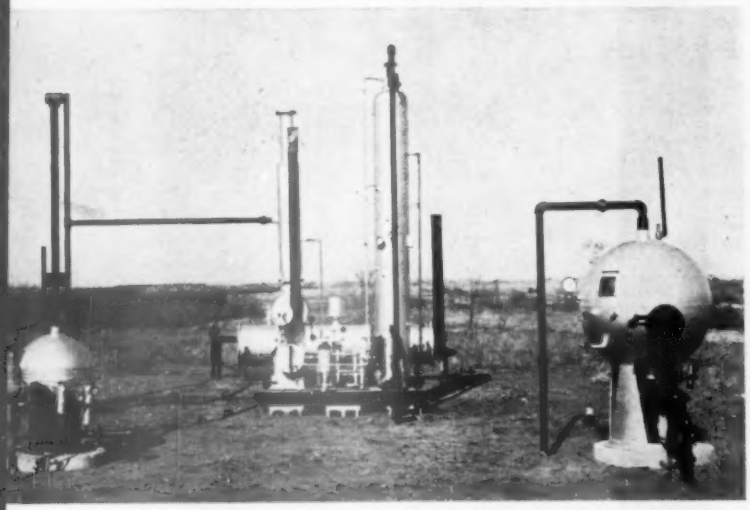

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Report on Canadian Operating Refineries

Location and capacities as of January 1, 1960

Province	No. Plants	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels Per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydro-treating	Production — Barrels Per Stream Day: Alkylation	Polymeri-zation	Lubes	Coke (Tons)	Asphalt
Alberta	10	91,620	98,130	26,400	19,170	22,190	7,100	19,005	14,875	.....	1,340	2,000	125	7,750
British Columbia	6	96,000	102,400	42,550	5,500	29,500	13,650	16,200	29,000	1,050	4,285	.....	.....	3,870
Manitoba	3	33,150	35,650	12,160	1,375	12,260	5,780	6,700	5,700	650	510	.....	.....	820
New Brunswick	1	280	300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Northwest Territories	1	1,350	1,600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nova Scotia	1	49,000	54,400	24,000	.....	15,000	12,000	7,000	7,000	.....	2,000	.....	.....	1,500
Ontario	7	242,850	272,140	100,920	11,055	81,420	29,450	45,935	49,800	.....	2,690	4,420	25	6,800
Quebec	5	265,000	284,000	100,000	36,730	99,920	13,740	46,720	66,720	3,000	6,250	330	80	18,300
Saskatchewan	6	62,730	68,400	26,400	16,850	21,100	18,950	9,050	10,300	870	1,140	165	100	6,025
Yukon Territory	1	2,850	3,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	41	844,830	920,020	332,430	90,680	281,390	100,670	150,610	183,395	5,570	18,215	6,915	330	45,065

Note: The legend for identifying types of processes is found at the beginning of the U. S. survey.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating: Unit	Hydrogen Treating: Feed	Production — Barrels per Stream Day: Alkylation	Polymeri-zation	Lubes	Coke (Tons)	Asphalt
Alberta														
Anglo American Exploration, Ltd.:														
Hartell	3,800	4,000	.....	[1]1,350	.....	.....	[4]1,000	.....	.....	.....	[3]60	.....	.....	.....
British American Oil Co., Ltd.:														
Calgary	6,750	7,500	2,500	[2]2,500	.....	.....	[6]3,000	.....	.....	.....	.....	.....	.....	600
Edmonton	7,650	8,500	.....	[1]1,400 [5]2,100	[12]2,000	2,000	[6]5,400	[15]6,300	Naphtha	.....	.....	.....	65	.....
Canadian Husky Oil, Ltd.:														
Lloydminster	7,820	8,500	2,100	.....	.....	.....	[12]400	[16]1,000	Mid. dist.	.....	.....	.....	.....	3,200
Canadian Kodiak Refineries, Ltd. (formerly Excelsior Refineries, Ltd.):														
Lloydminster	3,800	4,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,200
Imperial Oil Ltd.:														
Calgary	14,700	16,000	7,000	.....	[17]7,250	.....	[6]3,000	[23]3,000	Naphtha	.....	[21]1,000	.....	.....	550
Edmonton	28,500	30,000	10,300	[14]4,600	[18]8,500	5,100	[6]2,000	[23]3,700	Lubes	.....	.....	2,000	.....	.....
North Star Oil, Ltd.:														
Grande Prairie	2,100	2,500	.....	[1]1,000	.....	.....	[7]875	[11]875	Naphtha	.....	.....	.....	.....	.....
Texaco Canada Ltd.:														
Edmonton	12,000	NR	.....	[*]12,700 [*5]2,000	[*]4,000	.....	[*]3,000	.....	.....	.....	[*2]250	.....	[*]55	.....
Wainwright Producers & Refiners, Ltd.:														
Wainwright	4,500	4,500	2,500	[1]1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,200
Total†	91,620	98,130	26,400	19,170	22,190	7,100	19,005	14,875	.....	.....	1,340	2,000	125	7,750

*Barrels per calendar day. †Province totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating Unit	Hydrogen Treating Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
British Columbia														
British American Oil Co., Ltd.:														
Port Moody	18,000	20,000	9,000	.....	[1]9,000	4,500	[2]4,000	[3]7,200 [4]4,000	Naphtha Mid. dist.	[1]1,050	.....	.....	.....	.....
Imperial Oil Ltd.:														
Ioco	32,000	34,000	13,600	.....	[1]8,100	4,050	[5]5,500	[5]5,500	Naphtha	.....	[2]1,125	.....	.....	820
Royalite Oil Co., Ltd.:														
Kamloops	4,750	5,000	2,200	.....	[1]1,400	800	[1]1,000	.....	.....	.....	[2]110	.....	.....	700
Shell Oil Co. of Canada, Ltd.:														
Vancouver (Shellburn plant)	21,000	22,000	8,000	[2]4,500	[1]6,000	300	[1]2,500	[1]2,500 [6]9,300	Naphtha Mid. dist.	.....	[2]400	.....	.....	2,000
Standard Oil Co. of B. C., Ltd.:														
North Burnaby	18,000	18,900	8,400	.....	[1]5,000	4,000	[1]2,700	.....	.....	.....	[2]2,650	.....	.....	.....
X-L Refineries, Ltd.:														
Dawson Creek	2,250	2,500	1,350	[1]1,000	.....	.....	[4]500	[4]500	Naphtha	.....	.....	.....	.....	350
Total	96,000	102,400	42,550	5,500	29,500	13,650	16,200	29,000	.....	1,050	4,285	.....	.....	3,870
Manitoba														
Anglo-Canadian Oils, Ltd.:														
Brandon	2,650	3,000	.....	[1]1,375	.....	.....	[1]1,000	.....	.....	.....	[2]50	.....	.....	.....
Imperial Oil Ltd.:														
Winnipeg	18,000	19,150	7,300	.....	[1]7,000	2,100	[5]3,000	[2]3,000	Naphtha	[2]650	.....	.....	.....	820
North Star Oil, Ltd.:														
St. Boniface	12,500	13,500	4,860	.....	[1]5,260	3,680	[1]2,700	[1]2,700	Naphtha	.....	[2]460	.....	.....	.....
Total	33,150	35,650	12,160	1,375	12,260	5,780	6,700	5,700	.....	650	510	.....	.....	820
New Brunswick														
New Brunswick Oilfields, Ltd.:														
Weldon	280	300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Northwest Territories														
Imperial Oil Ltd.:														
Norman Wells	1,350	1,600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nova Scotia														
Imperial Oil Ltd.:														
Halifax	49,000	54,400	24,000	.....	[1]15,000	12,000	[5]7,000	[2]7,000	Naphtha	.....	[2]2,000	.....	.....	1,500
Ontario														
British American Oil Co., Ltd.:														
Clarkson	55,350	61,500	28,000	.....	[1]18,000	5,800	[6]10,000	[1]5]12,000 [1]5]8,000	Naphtha Mid. dist.	.....	[2]1,260	1,220	.....	4,000
Canadian Husky Oil, Ltd.:														
Fort William	3,500	3,800	1,300	.....	.....	.....	[6]1,000	[2]1,000	Mid. dist.	.....	.....	.....	.....	[6]800
Canadian Oil Companies, Ltd.:														
Corunna (Sarnia)	35,000	50,000	25,000	[2]3,500	[1]12,000	6,000	[1]10,400	[1]5,000	Mid. dist.	.....	[2]700	.....	.....	.....

Company and Location	Crude Capacity BPCD	Crude Capacity BPSD	Charge — Barrels per Stream Day: Vacuum Distillation	Thermal Operations	Catalytic Cracking: Fresh Feed	Catalytic Cracking: Recycle	Catalytic Reforming	Hydrogen Treating: Unit	Hydrogen Treating: Feed	Production — Barrels per Stream Day: Alkylation	Polymerization	Lubes	Coke (Tons)	Asphalt
ONTARIO (Continued)														
Cities Service Refining (Canada), Ltd.:														
Bronte	20,000	20,000	8,200	.....	[1]6,420	7,650	[7]3,870	.....	.....	.....	.....	.....	.....	.....
Imperial Oil Ltd.:														
Sarnia	94,000	100,000	30,000	.....	[1]25,000	10,000	[8]15,000	[2]15,000 [3]3,600 [4]4,600 [2]600	Naphtha Naphtha Lube Wax	.....	.....	3,200	25	2,200
Regent Refining (Canada), Ltd.:														
Port Credit	20,000	21,050	8,420	[2]4,000	[1]7,780	.....	[1]2,330	.....	.....	.....	[2]730	.....	.....	.....
Sun Oil Co., Ltd.:														
Sarnia	15,000	NR	.....	*[2]3,200	*†[3]11,000	.....	*[4]3,000	.....	.....	.....	.....	.....	.....	.....
Total‡	242,850	272,140	100,920	11,055	81,420	29,450	45,935	49,800	.....	.....	2,690	4,420	25	6,800

*Barrels per calendar day. †Total feed. ‡Province totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Quebec

British American Oil Co., Ltd.:														
Montreal East	45,000	50,000	17,000	.....	[1]22,000	3,000	[6]13,000	[15]17,000	Naphtha	.....	[2]630	330	.....	9,000
Canadian Petrofina, Ltd.:														
Montreal	29,000	30,000	14,500	[4]4,000	[3]11,000	3,000	[5]4,500	[5]5,000 [3]4,500	Mid. dist. Naphtha	[1]1,500	[2]450	.....	80	.....
Imperial Oil Ltd.:														
Montreal	72,000	79,900	35,500	[2]11,900	[1]21,200	4,240	[9]9,000	[2]9,000	Naphtha	.....	[2]2,300	.....	.....	3,300
Shell Oil Co. of Canada, Ltd.:														
Montreal East	60,000	62,000	33,000	[2]7,500	[1]23,500	3,500	[1]8,000	[9]9,000	Cat feed	[2]1,500	[2]1,200	.....	.....	6,000
Texaco Canada, Ltd.:														
Montreal East	59,000	NR	.....	*[2]12,000	*[2]20,000	.....	*[1]11,000	*[1]11,000 *[4]9,000	Naphtha Mid. dist.	.....	*[2]1,500	.....	.....	.....
Total†	265,000	284,000	100,000	36,730	99,920	13,740	46,720	66,720	.....	3,000	6,250	330	80	18,300

*Barrels per calendar day. †Province totals include crude capacities not reported and calendar-day figures converted to stream-day basis.

Saskatchewan

British American Oil Co., Ltd.:														
Moose Jaw	13,500	15,000	5,500	[1]1,500 [5]2,250	[1]4,500	5,500	[6]5,400	[15]6,300	Naphtha	.....	[2]390	..	100	1,200
Canadian Husky Oil, Ltd.:														
Moose Jaw	2,930	3,200	1,300	[2]1,300	.....	.....	[6]650	[2]1,000	Mid. dist.	.....	.....	.....	.....	800
Consumers' Co-Operative Refineries, Ltd.:														
Regina	15,200	16,000	6,500	[3]3,000	[1]5,000	5,000	.....	.....	.....	.....	[2]500	165	.....	.....
Imperial Oil Ltd.:														
Regina	22,500	25,000	10,700	[1]5,000	[1]9,000	5,850	[3]3,000	[2]3,000	Naphtha	[1]870	.....	.....	.....	725
Northern Petroleum Corp., Ltd.:														
Kamsack	1,000	1,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,000
Royalite Hi-Way, Ltd.:														
Saskatoon	7,600	8,000	2,400	[2]3,800	[1]2,600	2,600	.....	.....	.....	.....	[2]250	.....	.....	300
Total	62,730	68,400	26,400	16,850	21,100	18,950	9,050	10,300	.....	870	1,140	165	100	6,025

Yukon Territory

Alaska-Yukon Refiners & Distributors, Ltd.:														
Haines Junction	2,850	3,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Clean jet fuel is essential to safe jet aircraft operation. Today, all aviation fuels in current service may be provided the ultimate protection against fuel contamination. The new Warner Lewis 2-stage separator/filter eliminates jet fuel contaminants — free water and dirt. This new equipment developed by Warner Lewis Company, pioneer manufacturer of separator and filter equipment for aviation fueling, delivers the cleanest fuel ever demanded by commercial or military aircraft.

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COUNTRY-WIDE TESTS PROVE HOW TOTCO CONTINUOUS END-POINT ANALYZER CUTS CONTROL COSTS ...INCREASES YIELD

In major refineries from the East Coast to the West, the new Totco continuous End-Point Analyzer has demonstrated its ability to provide better control over product quality and yield. It quickly pays for itself and steps up profits. ■ *This sensitive instrument continuously indicates the Engler End Point of a hydrocarbon stock or commodity in an operating range of 200° F. to 700° F. It delivers reproducibility within ±1°F., with results that correlate with ASTM D86 or ASTM D158. And its continuous analysis cuts the usual delays between quality change and compensating plant control... eliminates the time lag of batch analyzers or conventional laboratory tests.* ■ *Write or call today for further information. Request Bulletin 5900-11.*

CASE HISTORY #1

Major Eastern Refinery

Use of the TOTCO End-Point Analyzer enabled this refiner to step up end-point specifications of reformer feed stock by 10°F with safety. Result: increased yield and a saving of over $200 a day. On the basis of this test, six additional Totco units were ordered!

CASE HISTORY #2

Major West Coast Refinery

Both TOTCO's End-Point Analyzer and Initial Boiling Point Analyzer were used here on a narrow-cut solvent. It was found that the analyzers kept yield on grade better than 99% of the time! Previous average with laboratory control was 90%.

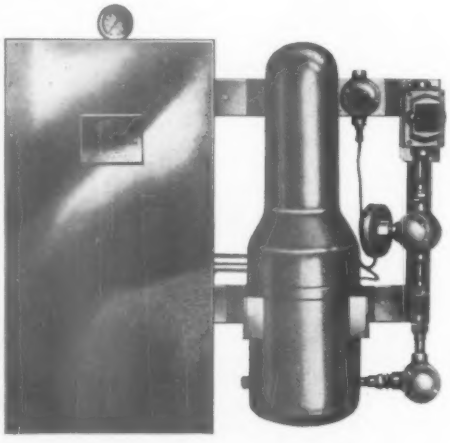
CASE HISTORY #3

Major Mid-West Refinery

In this test, the TOTCO End-Point Analyzer was mounted in a trailer and used on a crude still to control first-cut products on stream. So successful was the test that the company ordered two additional Analyzers for use at other refineries.

TOTCO CONTINUOUS INITIAL BOILING POINT ANALYZER

Totco also manufactures an Initial Boiling Point Analyzer. Write for Bulletin 1259-11 giving details and operating data.



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CASE HISTORY #4

Major Western Refinery

Demonstrating the versatility of the TOTCO End-Point Analyzer was this test where it was used to control the cut on heavy naptha. The test was a money-saving success, and the firm has since ordered additional units.

Where refineries are a-building

. . . and when they'll be completed—U. S. and Canada

THE LATEST SURVEY of refinery construction shows 53 projects under way or planned at U. S. refineries, and 13 in Canada.

This includes all projects scheduled for completion after January 1, 1960. Some of the plants and units are currently under way, and others are still in the planning stage.

The following report includes projects for both countries:

A

• **American Oil Co.,** Texas City, planned to complete a 10,000-bbl. delayed coking unit February 1960. Coke producing capacity will be 400 tons per day. **Tellepsen Construction Co.,** Houston, has contract.

• **Aurora Gasoline Co.,** Detroit, is increasing catalytic hydrogen treating capacity from 10,000 to 22,000 bbl. daily. The new 12,000-bbl. Unifining unit is scheduled for completion June 1960. Scheduled for completion in February 1960 was a 2,000-bbl. sulfuric acid alkylation unit. **Treco Construction Division of Vitro Engineering Co.,** Tulsa, won contract for both projects.

B

• **Bay Petroleum Co.,** Division of Tennessee Gas Transmission Co., Chalmette, La., was scheduled to increase capacity from 26,000 to 37,000 bbl. per day February 1, 1960, with **Bechtel Corp.,** San Francisco, contractor. New 2,500-bbl. hydrofluoric acid alkylation unit was to be completed March 1, 1960, with Bechtel contractor. Fluid cat cracking fresh feed capacity will be increased from 9,600 to 14,800 bbl. per day, and recycle capacity from 2,400 to 7,600 bbl. daily. Completion by **Procon, Inc.,** Des Plaines, Ill., will be June 1, 1960.

• **BP Canada, Ltd.,** Ville d'Anjou, Que., will complete a new 25,000-bbl. refinery in spring 1960, with **Lummus Co. of Canada, Ltd.,** Montreal, holding contract. It includes 15,000-bbl. vacuum capacity, 9,000-bbl. fluid cat cracking, 6,000-bbl. Platformer, 12,000-bbl. catalytic hydrogen treating unit, and 800-bbl. catalytic polymerization unit.

• **British American Oil Co., Ltd.,** Calgary, Alta., is boosting capacity from 7,500 to 11,500 bbl. daily and is adding a 3,500-bbl. hydrodesulfurization unit. Completion set for fall 1960, with staff doing the work.

At Clarkson, Ont., a 3,000-bbl. hydrofluoric acid alkylation unit will be completed in May 1960. **Procon (Canada), Ltd.,** Toronto, is contractor.

At Edmonton, Alta., capacity will be increased from 8,500 to 13,500 bbl. daily late in 1960.

C

• **Canadian Kodiak Refineries, Ltd.,** plans to build a refinery at The Pas, Man.

• **Canadian Oil Companies, Ltd.,** is building a refinery in the Innisfail area of Alberta with capacity to process 2,000 bbl. of crude and 4,000 bbl. of condensate. Facilities will include hydrodesulfurization and Platforming units.

• **Century Refining Co., Inc.,** Shallow Water, Kans. (near Garden City), is adding a 3,000-bbl. Thermofor unit and a hydrofluoric acid alkylation unit with capacity of about 800 bbl. daily. Completion is set for mid-1960. **Litwin Engineering Co.,** Wichita, has contract.

• **Champlin Oil & Refining Co.,** Enid, Okla., is increasing fluid cat cracking fresh feed capacity from 11,000 to 13,270 bbl. daily. Recycle capacity will be increased from 5,000 to 6,135 bbl. Hydrofluoric acid alkylation capacity will be increased from 1,500 to 1,936 bbl. daily. Company crew will complete both projects in May 1960.

• **Chemoil Corp.** plans to build a 40,000-bbl. refinery between New Orleans and Baton Rouge, with completion expected in January 1962. It is now in the design stage, with **Lummus Co.,** New York, holding design contract.

• **Consumers' Co-Operative Refineries, Ltd.,** Regina, Sask., will add a 3,000-bbl. Platformer and an 8,000-bbl. Unifiner in September 1960. Catalytic polymerization capacity was to be increased from 500 to 1,000 bbl. daily in February 1960.

• **Continental Oil Co.,** Billings, Mont., is boosting capacity from 12,000 to 14,600 bbl. daily, with completion in June 1960.

At Denver, Colo., Continental is adding 2,000-bbl. vacuum capacity, with completion in May 1960.

D

• **Debco Corp. of Texas,** Abilene, Tex., planned to develop 500-bbl. daily refining capacity by February 1, 1960.

• **DX Sunray Oil Co.,** Tulsa, is building a new MEK solvent dewaxing and deoiling unit to replace existing solvent dewaxing unit and wax press units. This will not increase lube production. Completion is set for September 1960.

E

• **Esso Standard Division** of Humble Oil & Refining Co., Baton Rouge, La., will increase fluid cat cracking fresh-feed capacity from 141,000 to 142,500 bbl. daily, and recycle capacity from 59,000 to 60,800 bbl., with completion in April 1960. A 9,560-bbl. Esso Hydrofining unit for lube oils, and a 1,760-bbl. unit for wax will be completed in July 1960, with **Nichols Construction Co., Inc.,** Baton Rouge, contractor. Lube-oil-producing capacity will be increased from 10,900 bbl. to 12,800 bbl. daily. One phase of this latter project, involving 500-bbl. capacity, will be completed by Nichols in July 1960. The additional 1,400-bbl. capacity will be completed by the Esso staff in December 1960.

At Bayonne, N. J., crude-charging capacity will be increased from 28,500 bbl. daily to 32,000 bbl., and vacuum capacity will be increased from 15,000 to 16,100 bbl. daily. **Bechtel Corp.,** San Francisco, has the contract for both projects, with completion set for fourth quarter 1960.

At the Bayway refinery at Linden, N. J., project to boost crude-charging capacity from 175,000 to 180,000 bbl. daily was set for completion in February 1960. Fluid cat cracking fresh feed capacity will be boosted from 73,000 to 88,000 bbl. daily, and recycle from 29,000 to 36,000 bbl. daily in May 1960.

F

• **Farmers Union Central Exchange,** Laurel, Mont., will expand capacity from 20,000 to 25,000 bbl. daily, with completion by staff in March 1961. Fresh feed capacity of cat cracking operation will be increased from 8,000 to 10,000 bbl. Recycle capacity will be increased from 2,000 to 5,000 bbl.

• **Florida Oil & Refining Co.** (Frontier Refining Co.) has acquired a deep-water site at Jacksonville, Fla., and plans a 10,000-bbl. refinery costing about $10,500,000. Construction delayed until supply of crude can be assured during crucial first year of operation.

G

• **Golden Bear Oil Co.,** Oildale, Calif., is studying economic feasibility of adding a 1,000-bbl. catalytic hydrogen treating for lubes. Such a project would not be undertaken before 1962 at the earliest.

• **Great Northern Oil Co.,** Pine Bend, Minn., is adding a 1,659-bbl. sulfuric acid alkylation unit, with completion by **Treco Construction Division,** Tulsa, Okla., July 1, 1960.

• **Gulf Oil Corp.** plans to build a

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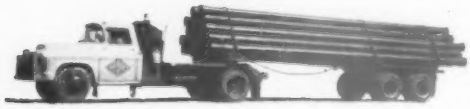
Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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new refinery near Charleston, S. C.

At Cincinnati, Ohio, Gulf will add a 10,000-bbl. Hydrobon catalytic hydrogen treating unit during the second quarter 1960. **Arthur G. McKee & Co.,** Cleveland, has the contract.

At Toledo, fresh feed capacity of fluid cat cracking will be increased from 15,500 to 17,500 bbl. daily, and recycle capacity will be increased from 3,500 to 13,500 bbl. daily by June 1, 1960, with **M. W. Kellogg Co.,** New York, holding contract.

H

• **Hess Trading & Transport, Inc.,** Sewaren, N. J., plans to add a fluid catalytic cracking unit, a vacuum unit, light ends recovery plant, catalytic desulfurization and alkylation facilities.

• **Humble Oil & Refining Co.,** Humble Division, Baytown, Tex., will increase vacuum capacity from 157,100 to 179,100 bbl. daily by March 1961, with Humble crews doing the job. Catalytic hydrogen treating will be increased 6,500 bbl. daily to 82,300 bbl. daily, by January 1961. The new 6,500-bbl. Esso Hydrofining unit will be used for lube oil.

• **Husky Hi-Power, Inc.,** Cody, Wyo., will increase capacity from 7,200 to 9,000 bbl. daily in January 1961. A 2,500-bbl. gas-oil cracking unit, and a 700-bbl. sulfuric acid alkylation unit will also be added in January 1961. Basic asphalt straight-run production capacity will be increased from 2,500 to 3,000 bbl. daily in July 1960.

I

• **Imperial Oil Ltd.,** Edmonton, Alta., will complete a 1,500-bbl. hydrofluoric acid alkylation unit in spring 1960. **Canadian Bechtel, Ltd.,** Toronto, has the contract.

• **Irving Refining, Ltd.** (Irving Oil Co. and Standard Oil Co. of California) was to go on stream at its new 40,000-bbl. refinery at St. John, N. B., in the first quarter of 1960. Facilities include a 13,000-bbl. fluid cat cracker (30% recycle), a 7,150-bbl. cat reformer, a 5,000-bbl. hydrodesulfurization unit, and a 2,500-bbl. hydrogen-treating unit. **Bechtel Corp.,** San Francisco, was contractor.

L

• **Louisville Refining Co.,** Louisville, will increase capacity from 11,000 to 16,200 bbl. daily by September 1960. **Myers Construction** has the contract. Fluid cat cracking fresh feed capacity will be increased from 4,000 to 5,000 bbl. daily, and recycle will be increased from 3,200 to 4,200 bbl.

M

• **Midland Cooperatives, Inc.,** Cushing, Okla., will complete a 1,330-bbl. hydrofluoric acid alkylation unit in April 1960. **Procon, Inc.,** Des Plaines, Ill., has the contract.

N

• **Naph-Sol Refining Co.,** Muskegon, Mich., plans to add a 5,000-bbl. Unifining unit, with completion tentatively scheduled in 1961.

• **National Cooperative Refinery Association,** McPherson, Kans., will add an 8,000-bbl. Unifining unit with completion July 1, 1960. **Treco Construction Division,** Tulsa, has contract.

P

• **Pacific Supply Cooperative** has a finished products terminal at Vancouver, Wash., with ultimate plans for a new refinery. No specific plans have been announced yet.

• **Palomar Oil & Refining Corp.,** Bakersfield, Calif., was scheduled to complete project boosting capacity from 1,300 to 2,800 bbl. daily in March 1960.

• **Pennzoil Division of South Penn Oil Co.,** Rouseville, Pa., will complete a 1,100-bbl. hydrofluoric acid alkylation unit June 1, 1960. **Procon, Inc.,** Des Plaines, Ill., has contract.

• **Petroleum Specialties, Inc.,** Flat Rock, Mich., plans to add 2,500-bbl. vacuum capacity, using company crew. Completion date not announced.

• **Phillips Petroleum Co.,** Phillips (Borger), Tex., will add a 25,000-bbl. heavy oil catalytic cracking unit, with **M. W. Kellogg Co.,** New York, contractor.

R

• **Regent Refining (Canada), Ltd.,** Port Credit, Ont., will increase calendar-day capacity from 20,000 to 26,000 bbl. in 1960. A new 4,700-bbl. Platformer will replace an existing 2,100-bbl. unit in 1960. Contractor for the latter is **Catalytic Construction of Canada, Ltd.,** Sarnia, Ont.

• **Richfield Oil Corp.,** plans to build a $50-million plant at Everett, Wash., with probable completion in 1965.

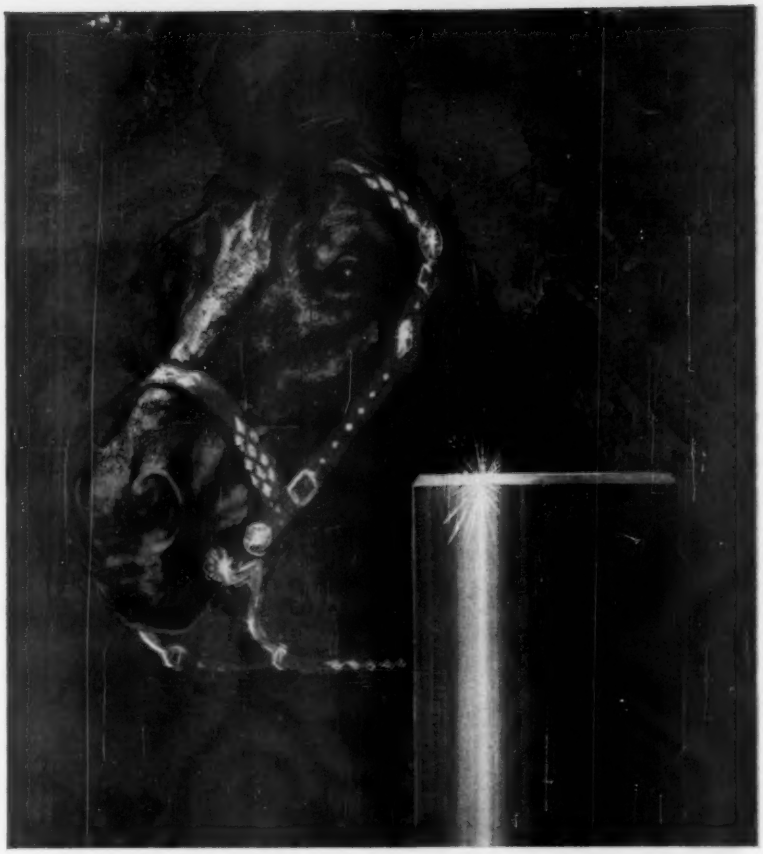
S

• **Shamrock Oil & Gas Corp.,** Sunray, Tex., has added a new Thermofor cat cracker with fresh feed capacity of 8,000 bbl. and recycle 7,000. Completion was set for February 1, 1960, with **Fluor Corp., Ltd.,** Los Angeles, contractor.

• **Shell Oil Co.,** Wood River, Ill., will boost Platforming capacity from 43,000 bbl. to 68,000 bbl., with completion in December 1960. **Arthur G. McKee & Co.,** Cleveland, has contract.

• **Shell Oil Co. of Canada, Ltd.,** may build a 20,000-bbl. refinery at Bronte, Ont., near Toronto.

• **Signal Oil & Gas Co.,** doing business as Bankline Oil Co., Bakersfield, Calif., will increase capacity from 10,200 to 15,300 bbl. daily by May 1, 1960, with company staff doing the construction. A 3,750-bbl. Sinclair-Baker cat reformer was set for com-



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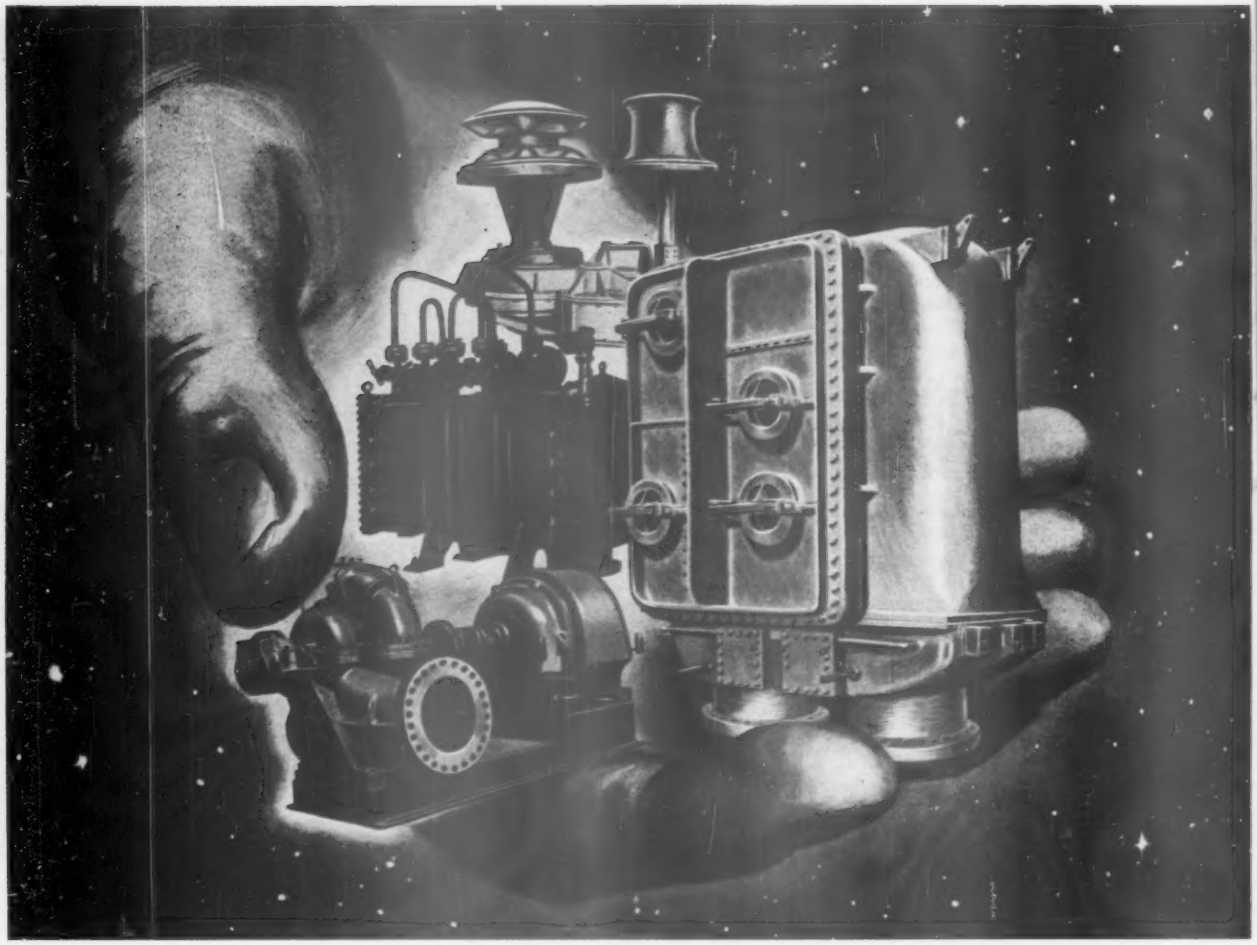

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lines offers important savings for management and engineering staffs engaged a variety of applications in power plants, marine, process and nuclear systems.

C. H. Wheeler Manufacturing Company, with 71 years' experience manufacturing condensers, ejectors, pumps and other components for the power, marine, process and nuclear industries, and Griscom-Russell, with 92 years' experience in the heat exchange field, are uniting to create an important pool of experience, products and services unmatched in industry today. The advantages offered by this combination are improved and increased selection, distribution and service, resulting in substantial savings for the current and potential customers of both companies.

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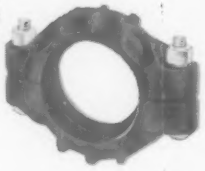

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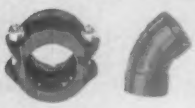
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pletion by **Ralph M. Parsons Co.,** Los Angeles, February 1, 1960. Capacity of fluid coking will be increased from 4,000 to 5,500 bbl. June 1, 1960, with staff handling the job. This will increase coke-producing capacity from 60 to 100 tons per day. Vacuum distillation capacity of 10,000 bbl. will be added by October 1, 1960, with Parsons contractor. An 8,000-bbl. Thermofor unit, with recycle capacity of 8,000 bbl., will be completed October 1, 1960, with Parsons contractor. A 500-bbl. catalytic polymerization unit will also be completed on that date by Parsons.

Signal may also build a new 40,000-bbl. refinery at Huntington Beach, Calif.

• **Southland Co.** has purchased a site at Black Point, Fla., for a proposed $8-million, 15,000-bbl. refinery.

• **Standard Oil Co. of California** plans to build a $75-million, 60,000-bbl. plant near Everett, Wash.

Near Honolulu, Hawaii, the company will complete its 32,000-bbl. per calendar day crude unit in October 1960. Scheduled for completion in mid-1962 are a 13,000-bbl. fluid cat cracking unit, with recycle of 13,000 bbl.; a 3,800-bbl. sulfuric acid alkylation unit; a 1,350-bbl. C_4 isomerization unit; and capacity to produce 500 bbl. of basic asphalt. **Bechtel Corp.,** San Francisco, and **Hawaiian Dredging & Construction Co.** have contracts.

• **Standard Oil Co. (Ind.),** Neodesha, Kans., will boost capacity from 24,300 to 24,800 bbl. Ultraforming capacity will be increased from 6,000 to 7,200 bbl., and catalytic hydrogen treating capacity will be increased from 6,000 to 7,200 bbl. Completion of all projects by company staff is scheduled July 1, 1960.

At Whiting, Ind., fluid cat cracking fresh feed capacity will be increased from 83,000 to 93,000 bbl., with completion by company forces in 1960. In 1961, a new 11,400-bbl. sulfuric acid alkylation unit will replace the existing 5,000-bbl. unit. **Bechtel Corp.,** San Francisco, has the contract.

At Wood River, Ill., a new 550-bbl. catalytic polymerization unit will replace the existing 170-bbl. unit by September 15, 1960, with **Procon, Inc.,** Des Plaines, Ill., holding contract.

• **Sunshine State Refineries, Inc.,** plans to build a 25,000-bbl. refinery in the Tampa, Fla., area, with date yet to be determined.

• **Suntide Refining Co.,** Corpus Christi, Tex., completed a new 7,000-bbl. delayed coking unit early in 1960. Coke production capacity is 325 tons daily.

• **Supertest Petroleum Corp.** is considering construction of a new refinery at London, Ont.

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DYE CONCENTRATES*

for cleaner, easier coloring of petroleum products; eliminate pre-dissolving, dusting, operator exposure • less skill and equipment required: introduced directly into finished product • the answer to bulk, tank, truck, tank car, barge, terminal and pipeline coloring • can be used with dry dye eductor equipment • use of dye concentrate involves no additional cost compared to ordinary dry dyes.

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Varec Pulse Code Telemetering Systems and automatic tank gauging equipment are fully described and illustrated in our Bulletin No. CP-3707. For immediate information or qualified engineering consultation, contact any of the Varec branch offices.

On-the-spot engineering and consultation services on Varec telemetering and gauging equipment is now as near as your phone. Through a newly established network of seven Varec branch offices and the strategic locations of new Varec warehouses, immediate delivery and service on all Varec products and parts is now assured. Manned by factory-trained electro-mechanical engineers, Branch offices have direct communication with the Varec home office via TWX and TELEFAX. These new, fully-staffed and fully-stocked branch offices guarantee close contact and service for Varec customers, when and where they need it.

For today's need and tomorrow's, Varec Pulse Code Telemetering Systems, combined with Varec tank gauging equipment, are the fastest and most accurate means of measuring tank liquid level, temperature and volume, and actuating remote equipment. Within five seconds, Varec Pulse Code Telemetering Systems gather information from tanks a hundred feet or hundreds of miles distant for immediate and permanent records and direct readings. No other systems offer the economy, freedom from error, and reliability that Varec provides.

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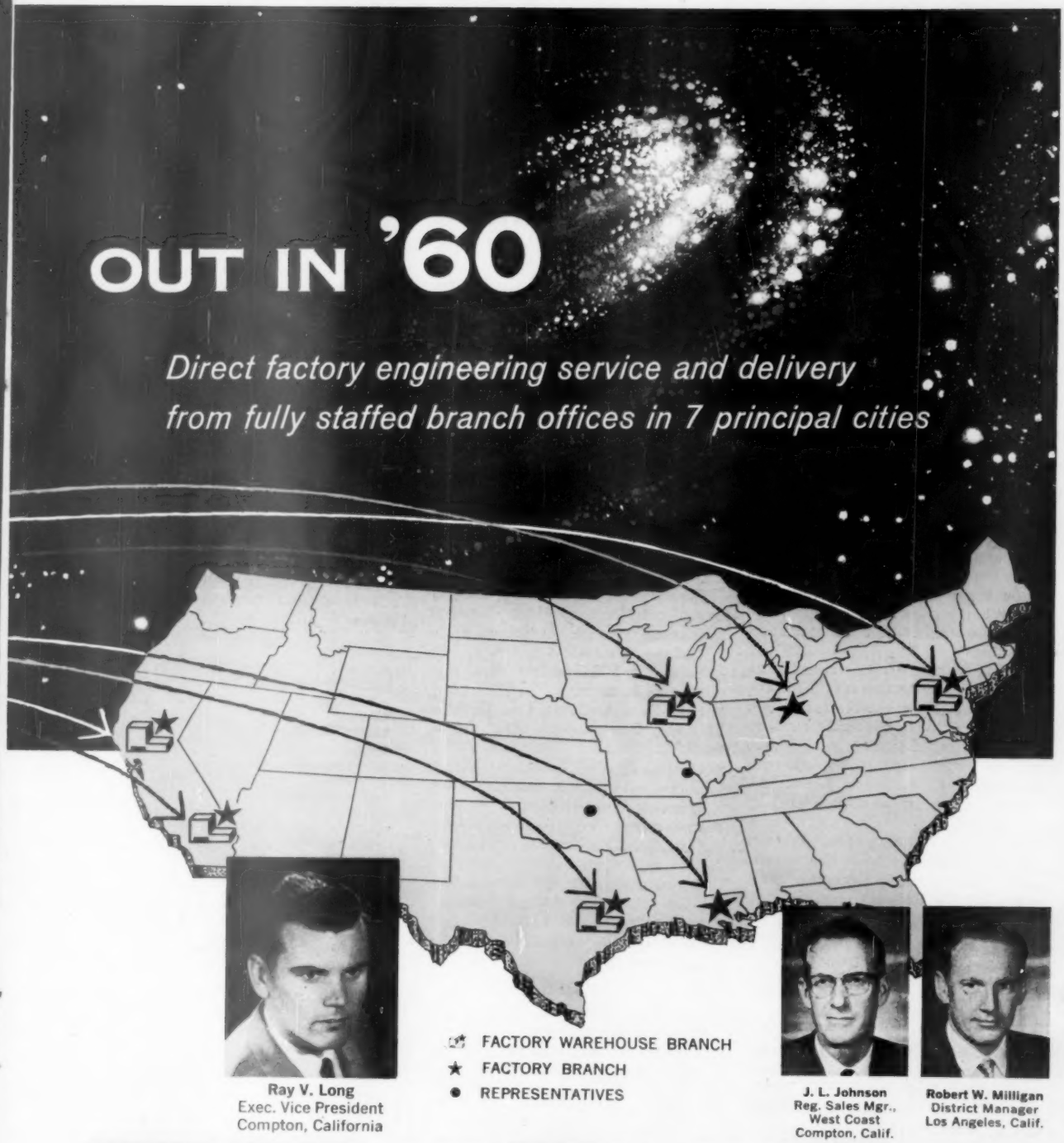
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Frank Gill
District Manager
New York, N. Y.

James R. Thompson
District Manager
New Orleans, La.

James E. Collins
Reg. Manager,
Gulf Coast
Houston, Texas

T

• **Texaco Canada Ltd.,** Montreal East, Que., will add 30,000 bbl. per calendar day of vacuum capacity in April 1960. Also scheduled for completion at that time is a 2,000-bbl. sulfuric acid alkylation unit, with **Foster Wheeler Corp.,** New York, contractor on the latter project.

• **Texaco Inc.,** Casper, Wyo., will add a new Hydrotreating unit, with capacity of 4,000 bbl. per calendar day. Completion scheduled January 1, 1961.

At El Paso, Tex., a new C_4 isomerization unit with capacity of 500 bbl. per calendar day will be completed May 1, 1960.

At Wilmington, Calif., Platforming capacity will be increased from 10,000 to 21,000 bbl. per calendar day, and a new Unifining unit, with capacity of 11,000 bbl. per calendar day, is under construction. Both units will be completed July 1, 1960.

U

• **Union Oil Co. of California** has purchased a 2,240-acre site about 33 miles north of Seattle. The company house organ described it as "an excellent site for a refinery if and when conditions make such an expansion advisable."

At the company's Los Angeles refinery at Wilmington, Calif., a 15,000-bbl. Sinclair-Baker cat reforming unit will be built, and Unifining capacity will be increased from present 14,000 bbl. to 56,000 bbl. Completion of projects by **C. F. Braun & Co.,** Alhambra, Calif., is scheduled last half of 1960.

• **United Refining Co.,** Warren, Pa., will complete a 1,100-bbl. sulfuric acid alkylation unit in December 1960.

• **U.P. Oil Refinery, Inc.,** is reassembling a 1,580-bbl. skimming plant at Rapid River, Mich., with completion by company crews April 1, 1960. Main crew source for this new plant will be western Canada via Interprovincial pipeline.

W

• **Wilshire Oil Co. of California,** Santa Fe Springs, Calif., will complete a 1,500-bbl. hydrofluoric acid alkylation unit May 1960, with **C. F. Braun & Co.,** Alhambra, Calif., contractor.

Plants not charging whole crude

ASPHALT

Byerite Corp., Heath, Ohio.

Capacity: 2,000 bbl. per day of straightrun and 5,200 bbl. of oxidized.

Monarch Refineries, Inc., Oklahoma City.

Capacity: 2,000 bbl. per calendar day of oxidized asphalt.

Pabco Building Materials Division, Fiberboard Paper Products Corp., Emeryville, Calif.

Capacity: 3,000 bbl. per day of oxidized.

Pabco Building Materials Division, Fiberboard Paper Products Corp., Portland, Ore.

Capacity: 525 bbl. per day of oxidized.

LUBES AND WAXES

Bareco Wax Co., Division of Petrolite Corp., Kilgore, Tex.

Capacity: 750 bbl. per day charge capacity for tank bottoms and selected petroleum fractions.

Bareco Wax Co., Division of Petrolite Corp., Barnsdall, Okla.

Capacity: 1,100 bbl. per day for wax making.

Calumet Refining Co., Burnham, Ill. (now operating on a partially refined lube distillate).

Capacity: Vacuum capacity is 750 bbl. daily. Lube-oil production capacity 700 bbl. per day. Crude unit shut down.

Cit-Con Oil Corp., Lake Charles, La.

Capacity: Charges 28,750 bbl. per day of petroleum fractions. Finished lube capacity is 10,000 bbl. daily.

Dallawax Co., Kilgore, Tex.

Capacity: 500 bbl. per day wax from tank bottoms.

Ultra-Penn Refining Co., Division of Borne Chemical Co., Inc., Bruin, Pa.

Operation: This company blends lube oils and manufactures sulfonates.

Warwick Wax Division of Western Petrochemical Corp., Chanute, Kans.

Operation: Facilities to make wax from tank bottoms.

Construction: 500-bbl. vacuum distillation unit, 350-bbl. propane deasphalting unit, and a 200-bbl. wax percolation unit. Contractor is **Litwin Engineering Co.,** Wichita, Kans.

OTHER

American Gilsonite Co., Grand Junction, Colo. (charging gilsonite).

Capacity: 4,500 bbl. per day delayed coking, 1,500 bbl. Platforming, 1,500 bbl. Unifining. Coke capacity 300 tons daily.

Construction: Delayed coking capacity will be increased to 6,000 bbl. per day, and coke production capacity to 400 tons per day. Completion scheduled April 1960.

Calstate Refining Co., Long Beach, Calif.

Capacity: Charges petroleum fractions to 2,600-bbl. visbreaker.

NGL Corp., Orange, Tex.

Construction: This company plans to build a plant at Orange to process natural-gas condensate, distillate, and natural gasoline. Capacity will be 20,000 bbl. per day. Project will include 10,640-bbl. Unifiner and 10,640-bbl. Platformer. Tentative completion date is April 1961.

Pacific Petroleums, Ltd., and **Phillips Petroleum Co.** (joint-interest operation), Taylor, B. C.

Capacity: 4,000 bbl. per day condensate, 2,000-bbl. Platformer, and 3,250-bbl. Unifiner.

Signal Oil & Gas Co., Signal Hill, Calif.

Capacity: 3,000-bbl. Ultraforming capacity, plus hydrogen treating for the reformer charge, are all that remain in operation at this 21,000-bbl. fire-damaged plant.

Shutdown plants in U. S. and Canada

Company and location—	Cap. bbl. per stream day
Alberta	
Bonnyville Oil & Refining Corp., Bonnyville	1,000
Kansas	
Chanute Refining Co., Chanute	2,000
Kentucky	
Aetna Oil Co., Div. Ashland Oil & Refining Co., Louisville	11,000
Louisiana	
Clark Oil & Refining Corp., Marrero	7,000
Manitoba	
Radio Oil Refineries, Ltd., East Kildonan	500
Michigan	
Aurora Gasoline Co., Elsie	6,700
Nebraska	
Searle Petroleum Co., Salem	1,000
New Mexico	
El Paso Natural Gas Products Co., Brickland	4,200
El Paso Natural Gas Products Co., Prewitt	5,000
New York	
Gulf Oil Corp., Staten Island	18,500
Ohio	
Ashland Oil & Refining Co., Findlay (in standby condition)	16,000
Western Reserve Refining Co., Div. Ashland Oil & Refining Co., Niles	6,000
Oklahoma	
Mercury Oil Refining Co., Oklahoma City	5,250
Wilcox Oil Co., Bristow	5,300
Saskatchewan	
Petroleum Fuels, Ltd., Moose Jaw	1,100
Royalite Oil Co., Ltd., Coleville	5,000
Royalite Oil Co., Ltd., Prince Albert	1,000
Tennessee	
Southern Oil Service, Nashville	800
Texas	
Cosden Petroleum Corp., Hawley	6,500
Gladewater Refining Co., Gladewater	2,500
Phoenix Refining Co., San Antonio	3,500
Sid Richardson Refining Co., Texas City	18,000
Texas Asphalt & Refining Co., Pasadena, Tex.	5,000
Wyoming	
Big D Oil Co., Sundance	125
Pilot Oil Co., Morton	250

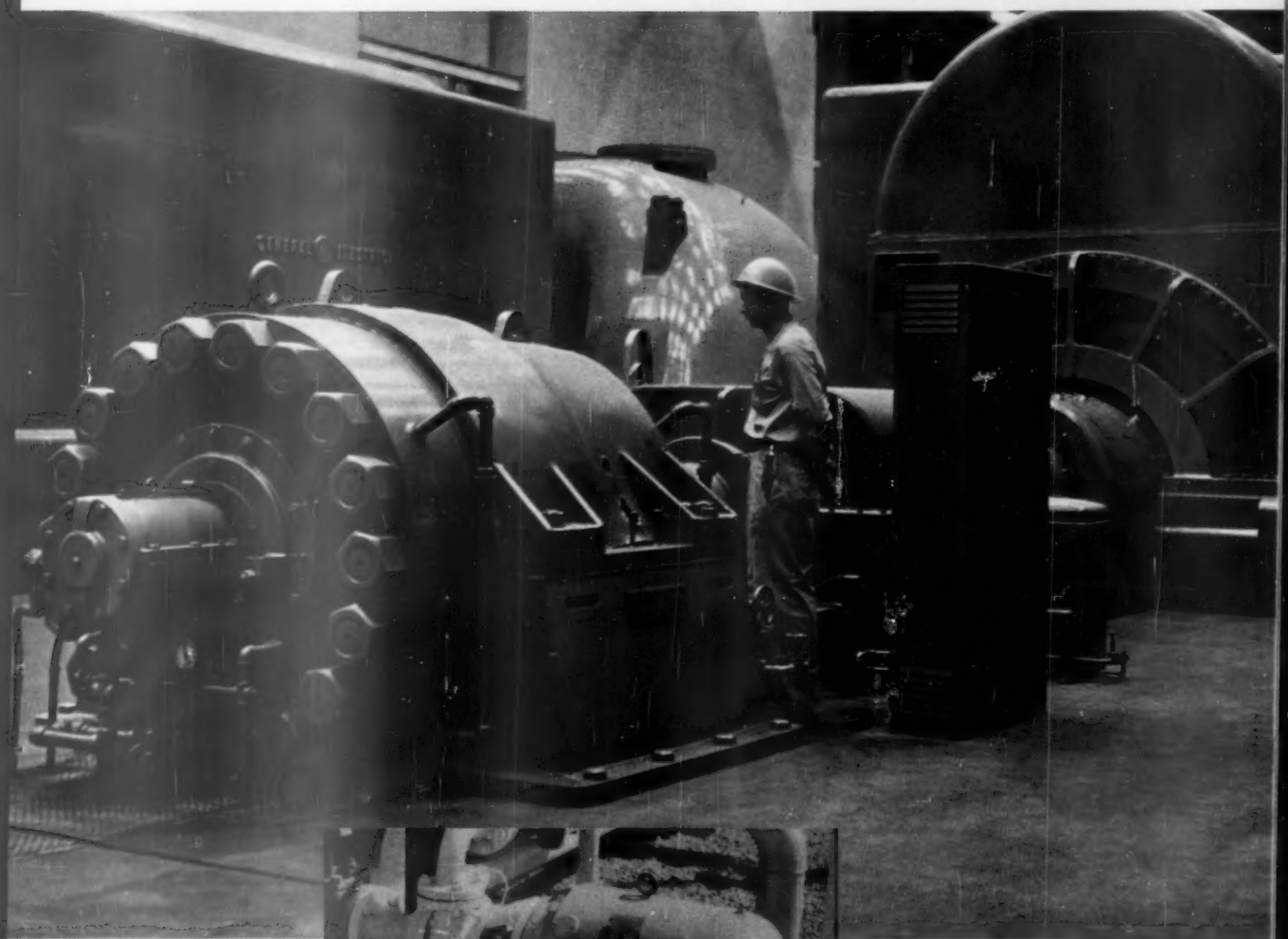
BJ Quality Pumps for every service!

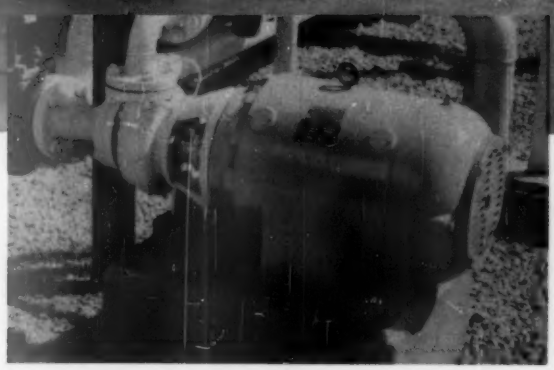
Pumps

Twelve thousand horsepower—directly from the main turbine-generator shaft—drives this BJ Boiler Feed Pump for Consolidated Edison's Astoria Unit #3. The first of four similar installations, this 3600 rpm pump delivers 6330 gpm, against a 6400 foot head.

The reliability demanded by such a continuous drive arrangement illustrates the trend towards more critical applications of centrifugal pumps, and of BJ's ability to meet these requirements.

From this giant, to the standard BJ Bilton model below, Byron Jackson can provide *the* quality pump for any service.





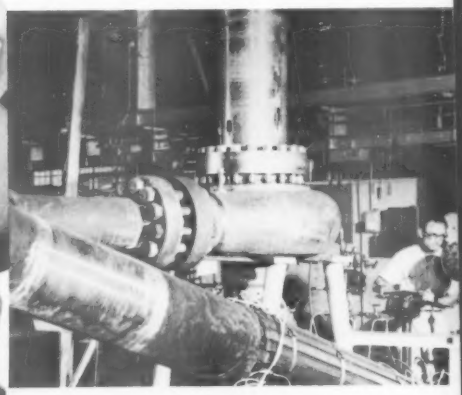
BJ

since 1872

Quality

HYDRAULIC TESTING puts BJ pumps through their paces before delivery...assures each design will perform as specified. Here, a BJ Vertical Circulating Pump is tested in BJ's newly enlarged test lab, which can handle pumps requiring horsepowers to 12,000, venturi capacities to 70,000 gpm.

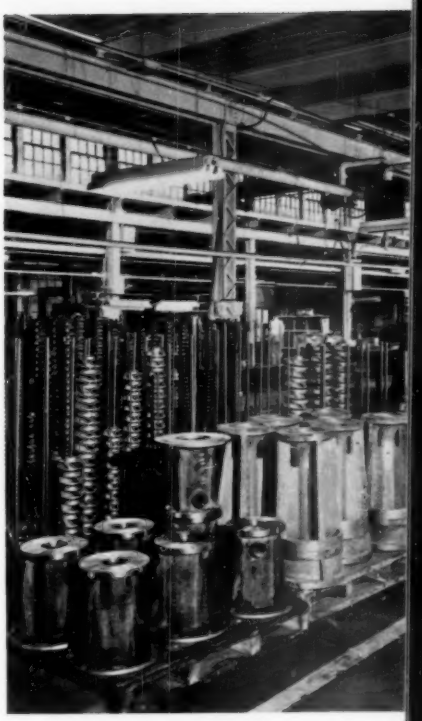
SPECIAL TESTING such as this continuous loop, high temperature test of a BJ Liner-Motor Nuclear Pump can be performed to meet any customer or governmental specifications.



PRECISE ALIGNMENT, here being performed on a special granite slab, is typical of both the special facilities available, and the care and skill of workmanship built into each BJ Pump.

BJ

Here's BJ's program for delivering a quality pump ...on time!



Quality takes time. Time for careful construction techniques, and time for the extra steps necessary to check, test, inspect and examine a quality product.

Byron Jackson works two ways to assure delivery of a quality pump as scheduled.

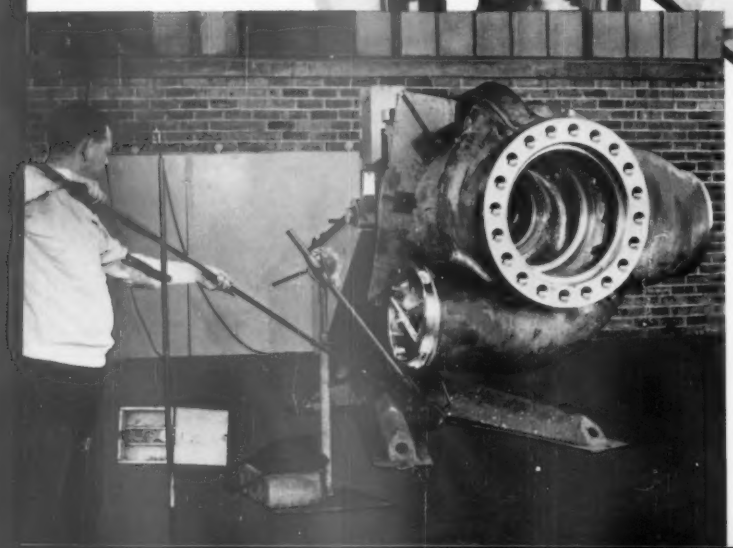
First, on standard type BJ Pumps, adequate inventories of all initial and spare parts are kept at strategic locations throughout the country. Complete pumps or parts can be delivered almost off-the-shelf!

For custom engineered BJ Pumps, an extra large and efficient engineering department is at your command to produce a pump to your specifications —yet with the background of BJ's experience in quality manufacturing since 1872.

After engineering approval, BJ's complete and advanced facilities, some of which are shown here, go to work to build your pump, and to prove its worth through the numerous tests.

Metallurgical control of materials, improvements in processing techniques and non-destructive testing assure a pump built to meet your most exacting specifications.

"CLEAN ROOM" facilities provide cleaning and final assembly of pumps in a completely dust-free atmosphere. It is used primarily for pumps going into nuclear or cryogenic service.



RADIOGRAPHIC INSPECTION of castings, shown here, as well as helium leak testing, dye penetration, ultrasonic and Magnaflux inspections are the type of control procedures used to build the quality in BJ Pumps.

Proved

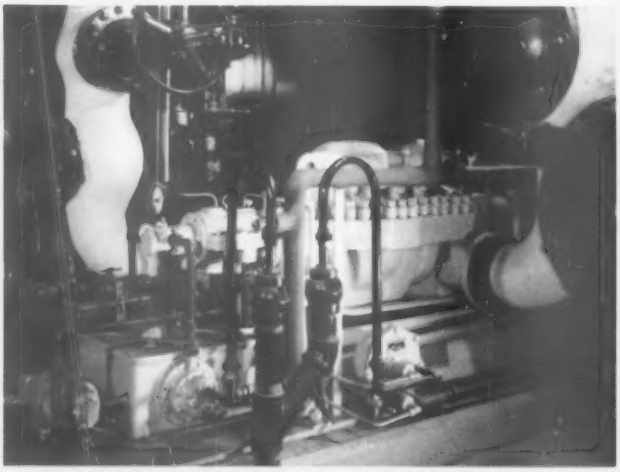
Proved reliable in every application!

The result of BJ's experience in building thousands of pumps for every type of service, is a remarkable record of "World's First's."

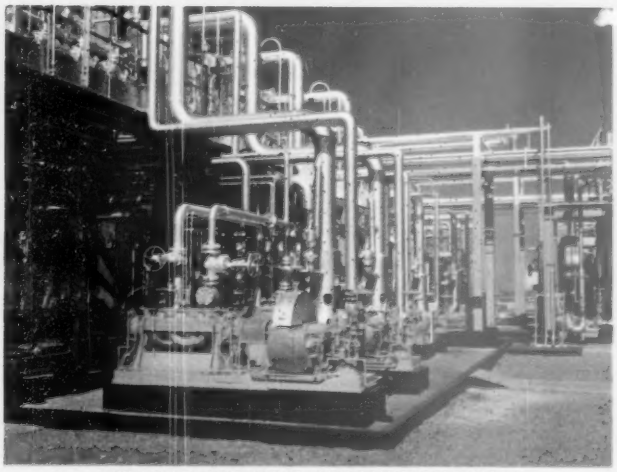
From the first deepwell turbine pump in 1901, to the current World's largest boiler feed and liquid sodium nuclear pumps, BJ has maintained leadership in pump building.

Name your application—BJ can match it with a reliable pump, proved in service, and backed by experience!

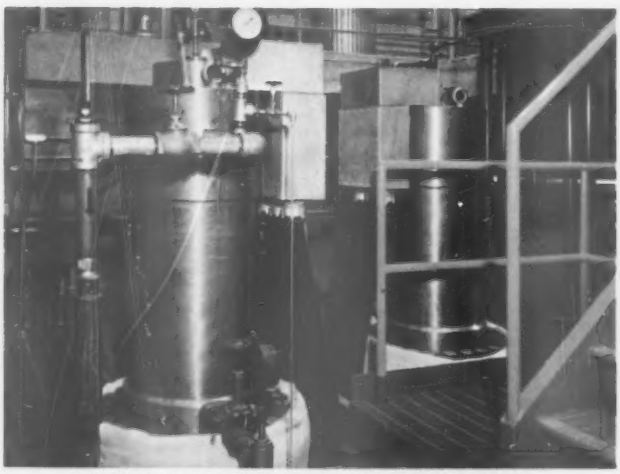
VERTICAL CIRCULATING AND DEEPWELL PUMPS



BOILER FEED, PIPELINE AND HIGH PRESSURE PUMPING



REFINERY, CHEMICAL AND PROCESS PUMPS



NUCLEAR REACTOR, PRIMARY COOLANT PUMPS

Byron Jackson Pumps, Inc.

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Let preplanning cut your drilling costs

BY S. C. OLIPHANT
Senior Vice President,
Tennessee Oil & Gas Co.

IF YOU WANT to know what good drilling planning looks like, study the accompanying drilling prognosis. With planning like this, and a cooperative spirit between operator and contractor, both these parties will be successful in their main objective, which is to obtain the most economical drilling possible.

I am not going to list the numerous items that can reduce drilling costs. But, some of you may remember the old Buick slogan: "When better automobiles are built, Buick will build them." Could it have been that the engineers of those days thought they had attained perfection? I think they did.

Then I ask you, do you think we in the oil industry have attained perfection in drilling techniques? I certainly hope that none of us have such thoughts, and I further hope that we will never attain perfection. Improvements in techniques brought about by study, research, and much practice will result in lower drilling costs.

This I state as a fact. This, however, is the **future**, and the future will be no better than we make it.

Applying the principle. Now for the present. How can we best apply what we have already learned? Like a doctor, first you must analyze the symptoms, next make a diagnosis, and then prescribe.

When you face a problem, don't let yourself be trapped by first reaching a conclusion and then finding reasons that support your conclusion. It is a very common mistake and can prove costly. Study all of the facts, get more data if possible, call in helpers, consult with others, and then draw your conclusions and make your

This article is from a paper given at Advanced Drilling Engineering Course, Texas A & M College, January 1960. The author's company is a division of Tennessee Gas Transmission Co., Houston.

PROGNOSIS TO DRILL AND COMPLETE

DISTRICT:	Great Bend	FIELD:	Nova
LEASE:	Henry Novotny TGT Lease No.: Kan 1715	WELL NO.:	3
LOCATION:	SW NE SW Section 17, T-22S, R-23W Hodgeman County, Kansas		
PROJECTED HORIZON:	Mississippi		
ESTIMATED TD:	4,700 ft.		
ESTIMATED ELEVATION:	2,370 ft. K.B.		
DRILLING PROBLEMS:	Minor loss of circulation zones from 2,100 to 2,900 ft. and tight hole through the chalk section found at approximately 3,100 ft.		

DAILY DRILLING REPORT:

Contractor's tool pusher or morning-tour driller will call in the previous 24 hours' drilling operations to the Great Bend District Office (Phone Gladstone 3-5417) between 8:00 and 9:00 a.m. each day except Saturday, Sunday and holidays.

DRILLING, SURFACE CASING, AND CEMENTING PROGRAM:

1. Drill 12-1/4-in. hole to approximately 400 ft.
2. Run and cement 8-5/8-in. o.d., 24 lb./ft., J-55, Condition A casing at approximately 400 ft. with 300 sacks of regular cement, premixed with 2% $CaCl_2$. Volume calculated to circulate cement to surface. Run one centralizer on bottom joint.
3. W.O.C. 24 hours. Drill out under surface casing with 7-7/8-in. bit. Drill 7-7/8-in. hole to approximately 4,700 ft.

ANTICIPATED FORMATION TOPS:

Heebner Shale----------3,925 ft. (-1,555 ft.)
Lansing-Kansas City----------4,000 ft. (-1,630 ft.)
Mississippi----------4,620 ft. (-2,250 ft.)

DRILLING MUD PROGRAM: Gel-Chemical-Salt Water

1. Drill surface hole with water-native mud, adding gel and loss-of-circulation material as needed.
2. Drill with water-native mud below surface casing to 3,000 ft. adding gel and loss-of-circulation material as needed.
3. At 3,000 ft. add sufficient oil to the native mud to obtain 8-10% oil by volume. Add chemical thinner in order to reduce gel strengths, viscosity, weight, and water loss. Maintain this mud condition to 3,900 ft.
4. Mud up at 3,900 ft. and maintain a viscosity of 38-45 seconds per quart, weight 9.8-10.2 lb./gal. water loss of 15 cc. or less, and 8-10% oil by volume from 3,900 ft. to TD.

DRILLING TIME AND SAMPLES:

1. Keep 1-ft. drilling time from 3,500 ft. to TD.
2. Catch 10-ft. samples from 3,500 ft. to TD.
3. Catch 15-minute circulating samples at the discretion of the company representative at the well.

CALL POINT, TESTING AND CORING PROGRAM:

1. Call Tennessee Gas & Oil representative at 3,900 ft.
2. Stop and circulate at 4,100 ft. if representative is not on location.
3. Drill to approximately 4,625 ft. or 2 ft. into Mississippi. Run 6-1/8-in. o.d. diamond core head with 50 ft. barrel and cut approximately 50 ft. core. Ream core hole and drill 60 ft. below lowest pay zone.
4. Drill-stem test any show of oil at discretion of wellsite company representative.

(Continued on next page)

(Continued from previous page)

DRILL-PIPE TALLIES:

1. Tally drill pipe last trip before reaching 3,900 ft.
2. Tally drill pipe for each drill-stem test.
3. Tally drill pipe at total depth.

DEVIATION SURVEYS:

1. Maximum allowable deviation from surface to surface casing point 1/4°.
2. Maximum allowable hole deviation 1° at 1,000 ft., 2° at 2,000 ft., and 3° at TD.
3. Maximum permissible variation in slope is 1° per 300 ft.

WELL SURVEYS:

1. Run gamma ray-neutron log from TD to surface casing. Run detailed gamma ray-neutron and Laterolog surveys from TD to 3,800 ft.
2. Run gamma ray-collar log for perforating control from the float collar to 100 ft. above shallowest pay.

PRODUCTION CASING AND CEMENTING PROGRAM:

1. Run and cement 5-1/2 in. o.d., 14 lb./ft. J-55, ST&C casing through the deepest pay zone and allow 30 ft. from the float collar to the lowest perforations in the deepest pay zone. Float collar will be run one joint above guide shoe.
2. Cement with 70 sacks 50-50 Pozmix with 2% gel followed by 40 sacks 50-50 Pozmix with latex material. Volume calculated to cover shallowest pay interval with 300 ft. cement.

PRODUCTION CASING AND CEMENTING PROGRAM:

3. Run staging collar at approximately 1,650 ft. and displace with 135 bbl. of dielectric fluid. Volume calculated to circulate to surface.
4. Run one centralizer on float joint and centralizers at 100-ft. intervals through the cement column. Run centralizers at 300-ft. intervals from staging collar into surface casing.
5. Land casing as cemented.
6. Move out rotary tools.
7. W.O.C. 48 hours.

COMPLETION:

1. Move in and rig up cable tools.
2. Swab casing dry and drill out stage collar.
3. Swab down and clean out casing to float collar.
4. Run gamma ray-collar log for perforating control.
5. Perforate Mississippi pay.
6. Test natural.
7. If necessary, acidize with 250 gal. mud cleanup acid.
8. Test on swab.
9. Run tubing, rods, and subsurface pump.
10. Test on pump.

Prepared By:_____

Approved By:_____
District Engineer

Approved By:_____
District Superintendent

recommendations or take the necessary action.

But how does all of this reduce drilling costs? If drilling costs can be reduced, we must presume that they are now too high. This could only mean waste and inefficiency. I don't believe these two words can be separated. Will any of us admit to waste? I am sure we would do anything to avoid this. Our efforts toward reducing costs, eliminating waste and inefficiency, should be concentrated first on the most important items.

Little excuse for WOO. To me the most inexcusable waste is WOO (waiting on orders). WOO should not occur if we make adequate plans and preparations and here, I think, is the most effective way that drilling costs can be reduced.

I believe we all recognize that the cheapest way is not always the most economical way. You don't necessarily buy the cheapest shirt, the cheapest suit, the cheapest automobile tire. You buy the one that is best suited to your needs. Drilling is no different. First you must determine your needs, then you can design and plan around these needs.

From the operator's standpoint, the most expensive part of drilling is the contractor's fee so it behooves the operator to consider his contractor carefully as to equipment, personnel, performance record, dependability and so forth. Having made sure that you have equipment and personnel to suit your needs, the next step is to prepare a drilling prognosis.

H. L. Strider[1] states that a detailed drilling procedure is a step toward achieving maximum drilling efficiency. I think it is possibly the biggest step in this direction.

Another says, "Cooperation and planning can mean profit to everyone." As evidence of this, in Elk City field in Oklahoma the discovery well cost $17 per foot. The price dropped immediately to $10 a foot, and finally leveled off at $6.75 per foot.[2] Of course, many things permitted the large price reduction. However, in my opinion most of the credit goes to proper planning and cooperation between operator and contractor.

Bibliography

1. "Minutes Are Money—Plan Your Well," World Oil, October 1956.
2. Ibid., staff article.

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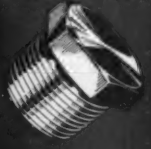

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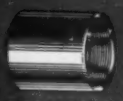

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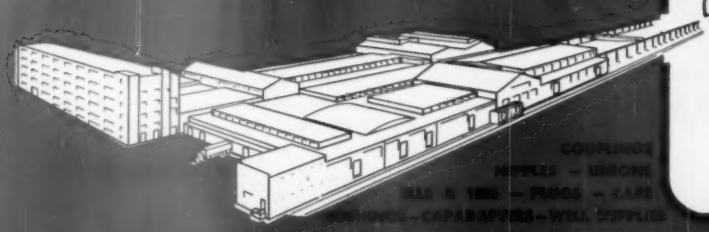

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German crude line remote controlled

• The 230-mile 28-in. Wilhelmshaven-Cologne system, costing $46,200,000, was designed for 200,000 bbl. daily with one station and 500,000 bbl. daily with four stations. The line is remotely operated from Wilhelmshaven via control and communication circuits leased from the government telephone system.

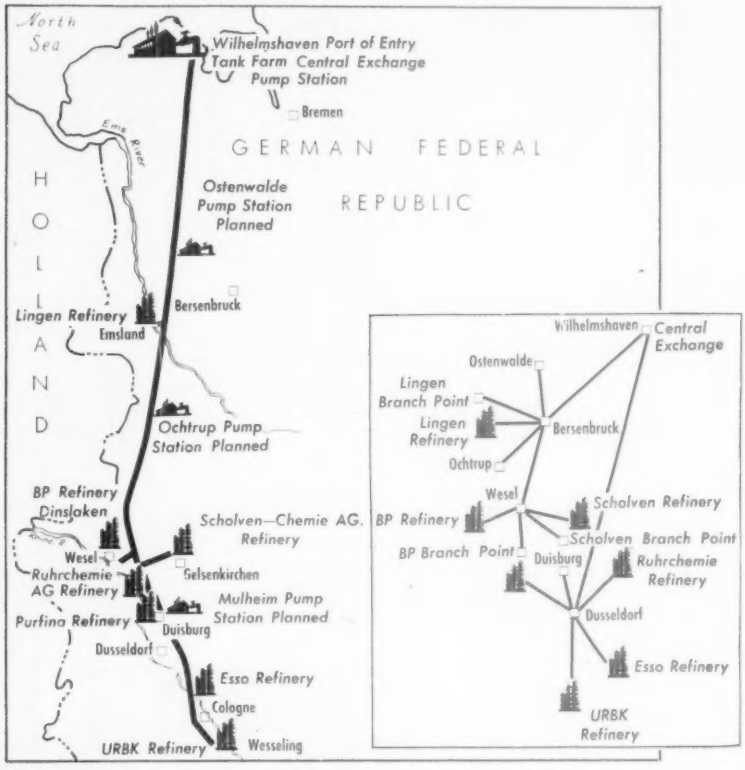
BY M. SWISS
London

EUROPE'S most modern crude-oil pipeline, completed in 1958, is delivering automatically almost 10 million tons of crude annually to seven refineries in Germany. (See Table 1.) Throughput will be increased with the growth of German refining capacity.

The project, called Nord-West Olleitung G.m.b.H. (North - West Oil Pipeline Co.) originates at the port of Wilhelmshaven, where the River Jade flows into the North Sea (Fig. 1). At Wilhelmshaven are located a 705-m.-long T-shaped jetty, capable of handling tankers up to 100,000 d.w. tons; an extensive tank farm; and a pump station.

The tanks and pumps are cross-connected with the pipeline so that transfer from one tank to another can be made in an emergency with booster pumps. The booster pumps enable adequate pressure to be maintained at the head of the pipeline. Three electric-driven centrifugal pumps are capable of delivering oil into the 28-in. main line at 60-70 kg. per sq. cm. (1,000 psi.).

The dispatcher at Wilhelmshaven can gage all tanks, measure temperature, operate tank-farm manifold and tank valves, and operate takeoff valves for refinery deliveries. He will also have control of unattended pump stations. The dispatcher watches his telemetered gravity reading from the main-line takeoff for a refinery and pushes a button for delivery when the proper gravity arrives.



MAP of crude oil pipeline, pump stations, and refinery connections. Inset is a diagram of communication facilities. Fig. 1.

Communication design. The design of the communications system was based on these requirements: (1) The need for transmission of specific-gravity determinations, which are made automatically, (2) the need to transmit direction-instructions from Wilhelmshaven to valve locations, and (3) the need for a central exchange for speech and teleprinter connection between Wilhelmshaven and all substations. This has been done within the existing framework of telegraph and telephone communications of West Germany without laying extra cables or upsetting the system.

The central station collects and displays information from along the pipeline and from the tanks. The supervision table (dispatching board) is divided into fields, each covering one pumping station, existing or planned, and one for each refinery or tank farm. Intsructions and measurements are passed from Wilhelmshaven to distant points by telemetering.

The "field tables" register in three-colored inks the pump pressures at Wilhelmshaven, and the pressure in, pressure out, and density of oil at remote points.

Pressure and density measurements. Pressure measurements are taken by measuring stress bands without upsetting the oil in transit. Within the stress-band manometer, in a cylinder, lies a Konstantan wire which forms an arm of a Wheatstone bridge. The stream of oil passes through it and is excited by wave motion. The arrangement is sensitive to within ±¼%.

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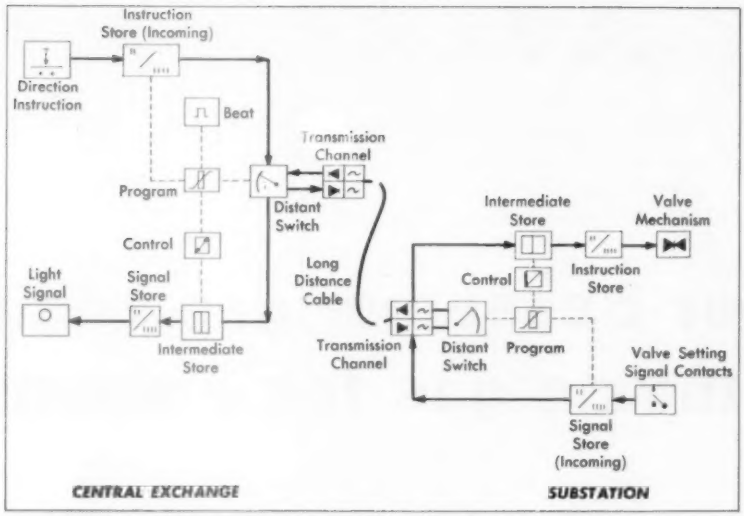


BASIC ARRANGEMENT for pulse-code long-distance stations. Fig. 2.

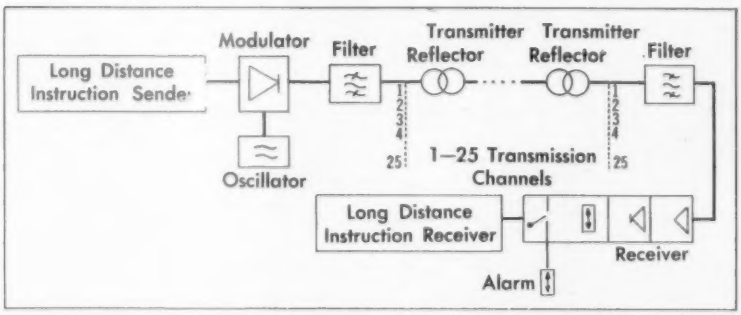
Density measurements are made by taking the weight of a unit volume of a sample taken from the main stream by an electrically operated pump. The two results are transmitted by impulse frequency changes of a range of 5 to 15 c.p.s. They have a rectangular wave form and represent a change of polarity at the receiving end. The incoming impulses operate a relay and place a charge on one of the two condensers by connecting one or the other to a d.c. source. The current which flows into these condensers does so at the same frequency as the original impulses and so provides a means of measuring the density, which is then recorded.

Pulse code. A method has been developed for transmitting instructions along the limited channels available: A code of pulses is used since to each station three instructions might have to be sent (Fig. 2). These require three acknowledgments, and, after action, three reports; each may be either positive or negative.

All this refers to opening and closing of valves. Up to 14 different signals may have to travel each way, the remainder relating to operating conditions and parameters. By its adaptability the pulse code proved itself outstanding as a communication channel.

Directional instructions (a modulated signal) go to a store from which part of the stimulus operates a switch and part goes along another conductor through a programer; into the programer a continuous modulated signal is also fed. Normal pulse lasts 30 milliseconds and the normal pause 70 milliseconds; there are also long impulses and double impulses, as well as end-of-message impulses. Each signal has to be acknowledged at the receiving end as well as acted upon.

In normal conditions it takes 2 seconds to pass an instruction; in case of atmospherics the signal is repeated twice by the sending end and once by the receiving station. Changeover from calling signals to instructions is done by synchronized relays. For the future an adaptation of this plant to programing would not be difficult. The code can be enlarged by supplementing it.



BASIC ARRANGEMENT for frequency-multiplex long-distance stations. Fig. 3.

TABLE 1—PARTICIPANTS IN THE PIPELINE AND REFINERIES ALONG IT, WITH TONNAGE

	Share %	Tonnage/ year
Lingen Erdoel Raffinerie Emsland	none	1.0
BP Ruhr Raffinerie Dinslaken	26.3	*4.5
Scholven-Chemie A.G., Werk-Scholven Gelsenkirchen	7.7	2.0
Ruhrchemie AG. Oberhausen	3.7	2.0
Purifina Mieraloel Raffinerie Duisburg	8.3	†1.0
Esso AG. Raffinerie Koln	47.2	3.5
Union Rhein. Braunkohlen Kraftstoff AG, Werk Wesseling	6.8	3.0
	100.0%	‡17.0

*On stream later this year. †Rising to 3.0. ‡Rising to 19.0.

Communications. The system is confined to the audio-frequency band. Since the band width needed is small, the multiplex system can be used without interfering with ordinary long-distance conversations of the West German telephone system (Fig. 3). The modulation is carried by a carrier frequency of 120 c.p.s. Because it comprises positive and negative potentials, the pipeline signals occupy a double width of modulation, forming together ±8% of the band, or 25 c.p.s.

The communication network consists of two groups: the central exchange at Wilhelmshaven, which is divided into the Bersenbruck and Wesel exchanges, and the southern exchange at Dusseldorf, serving the remainder. Cables to various substations that radiate from these points are the ordinary German postal (telephone) lines.

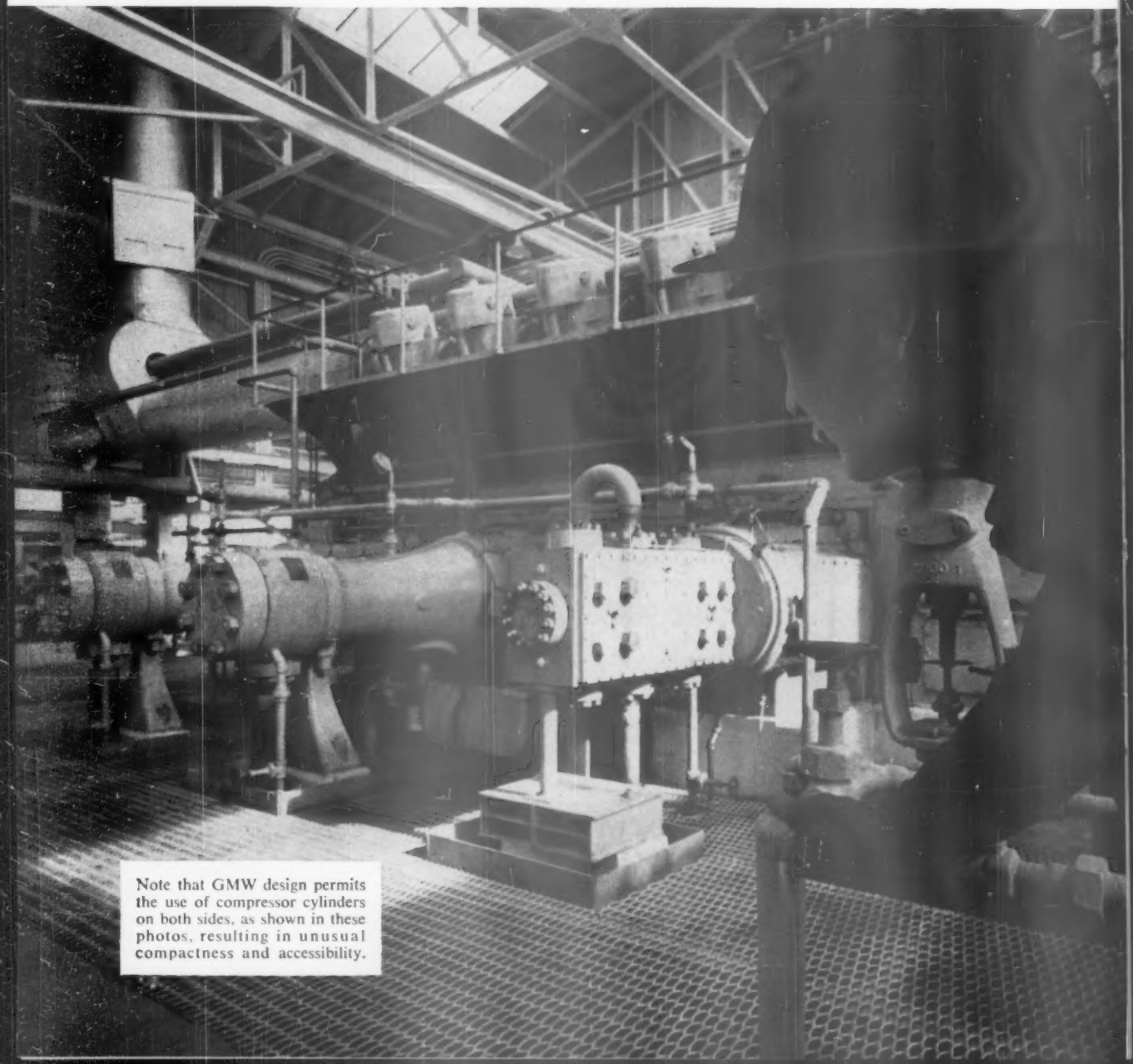
Plans for a teleprinter circuit were envisaged at an early stage. This was to have used a closed ring system. With expansion of the present pipeline it may have to be considered again. There is also a speech circuit for the operation of the pipeline. This operates apart from the signal and instruction circuit and is, in fact, the normal system used in Germany, operating from Wilhelmshaven via Mulhiem. The two systems function by normal telephone potential of 60 volts at 50 amp. but the measuring system operates on 220 volts.

Acknowledgment

The cooperation of Siemens & Halske Actiengeselschaft in supplying material for this article is gratefully acknowledged.

Report from American Cyanamid, Fortier Plant...

How Cooper-Bessemer gas engine boost synthesis gas for ammonia



Note that GMW design permits the use of compressor cylinders on both sides, as shown in these photos, resulting in unusual compactness and accessibility.

compressors to 5000 psi

These photos show both sides of one of the two Cooper-Bessemer 2500 hp GMW gas engine compressors at the Fortier Plant of American Cyanamid Company, Avondale, Louisiana. In the production of anhydrous ammonia, these 4-stage units compress 6000 cfm of synthesis gas from 60 psi to a discharge of 5000 psi. The left-hand view shows the high pressure cylinders; that on the right shows the low pressure side. The four stages of compression from 60 psi are (1) to 225 psi, (2) to 670 psi, (3) to 1500 psi, (4) to 5000 psi.

The two units have been operating since 1954, 24 hours a day, 340 days a year.

The anhydrous ammonia produced at the Fortier Plant is used by American Cyanamid in the manufacture of Acrylonitrile and is sold to fertilizer plants and other chemical companies.

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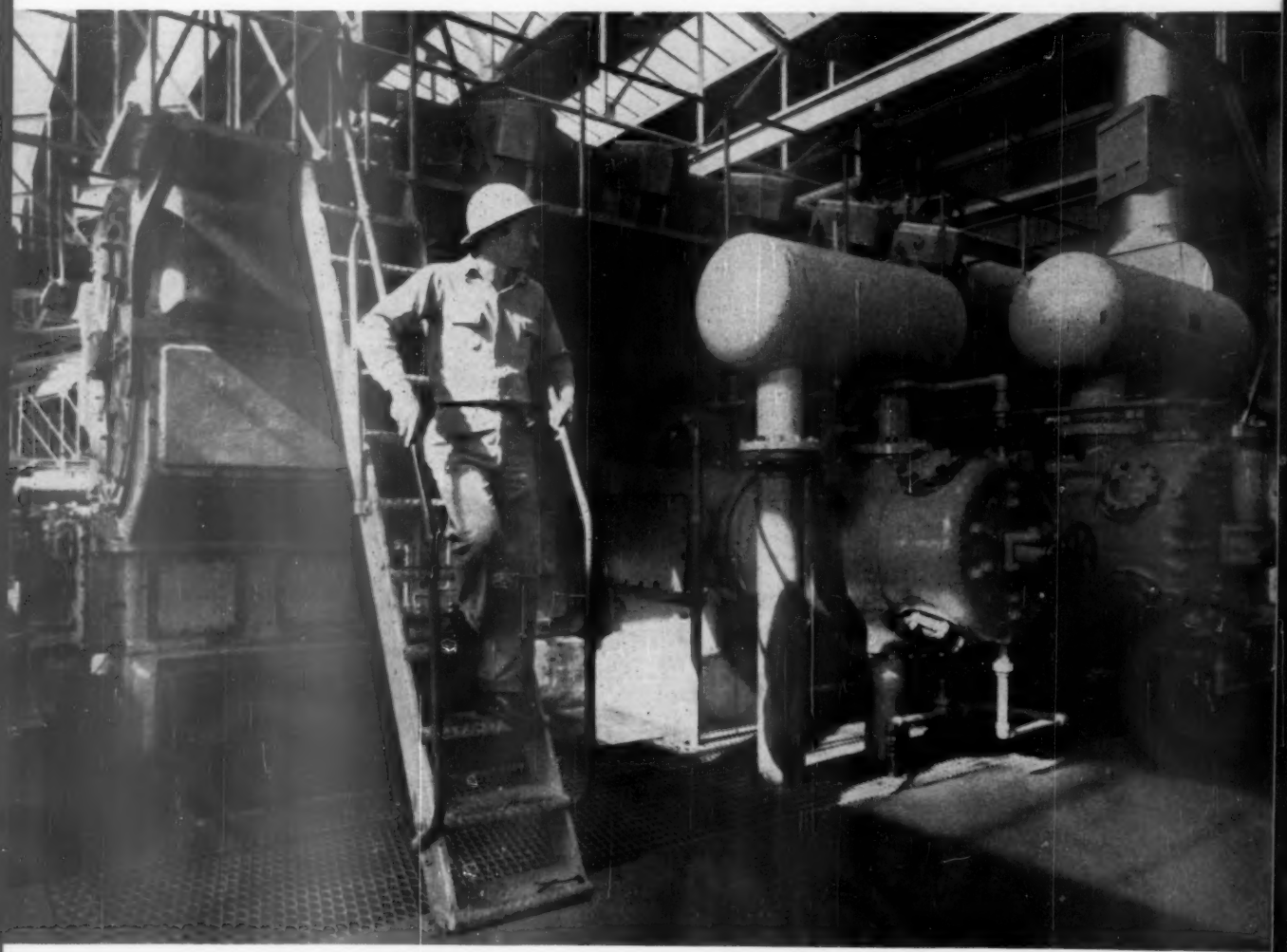

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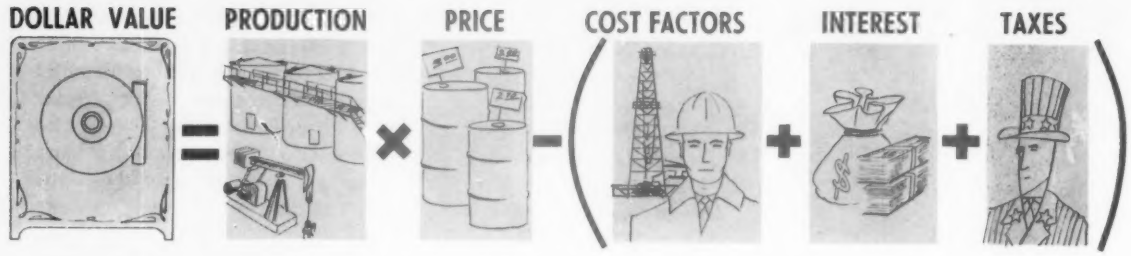


A fast way to evaluate reserves

• Long, year-by-year, evaluation of reserves can be avoided by using a short-form mechanical calculation. The permissible range of variation of the factors involved in the evaluation is considered to retain accuracy.

BY E. A. HARTSOOK
San Francisco

THE NORMAL reserve valuation is a lengthy, time-consuming process. It involves, first, estimation production by years and then requires detailed annual calculations of the gross income to be anticipated, the costs that will be applied against this annually, and the tax burdens that must be carried. Finally, all of this must be brought back by present-worth-type discounting procedure to a current value reflecting the effect of compound interest on money invested and value received.

In individual cases, many hours of time can be spent in the mechanical development of this type of calculation. The purpose of the procedure presented here is to shorten the time involved in these calculations. This is done with no appreciable loss of accuracy since this short-form procedure can be readily adapted to a variety of future conditions.

Realistically, it must be recognized that there is a significant margin of error in any oil-field-valuation problem when the variations in technical and economic factors are honestly appraised. In far too many cases, emphasis is placed upon detailed calculations of one phase of the problem, such as production predictions, while at the same time factors of almost equal import, such as price, production allowables, and interest rates, are considered only curiosity. The purpose of a shorter form mechanical calculation, then, is to allow the analyst to spend his time investigating the range of variation that can be experienced in the key factors affecting the final answer.

The tedious year-by-year calculation of present values may be accomplished by solution of one equation, or a combination of a very few equations. Fundamentally, it may be shown that, if $C = (1 - d)/(1 + i)$, where d = % decline and i = interest rate), total present worth of a reserve over n years $= -0.58PV(1 - c^n)/\log_e c$ if P = initial production in barrels per year and V = price.

Derivation

Many production computations can be expressed in terms of constant percentage decline for the entire estimated life of the reservoir. In other cases, production estimates can be made by combining two or three different percentage decline periods to form the total production curve. In

such situations, the total valuation equation would be solved separately for each time period.

For the purpose of this paper, constant percentage production decline is expressed as:

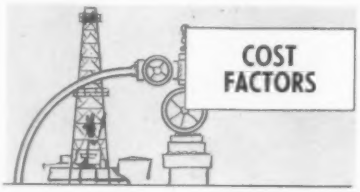
$$P_n = P\,(1-d)^n \qquad (1)$$

Where:

P_n = annual production in year n, bbl. per year.
P = initial production, bbl. per year.
d = percentage decline.
n = time in years.

It should be recognized that this equation determines year-end values. If midpoint values are needed, appropriate adjustment should be made.

Cost factors throughout the esti-



mated productive life of the field can be broken into two elements. The first, capital expenditure, is a direct function of the number of wells projected and can usually be estimated quite readily as a capital-investment total to be spread over the first few years of productive life. In most valuation problems, the discounted value at initial time of this investment can be quickly determined as:

$$I = I_w(w-i)^n \qquad (2)$$

Where:

I = discounted capital investment.
I_w = estimated cost per well, dollars.
i = discount rate.
w = projected number of wells.
n = time in years.

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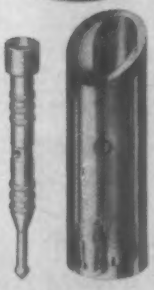

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As early as 1953 Axelson had a well-established Two-Zone Service Department when Texas was averaging less than 300 multiple completions per year. Now, with multiple completions up 65% over 1958, and running as high as 2200 per year in Texas, Axelson continues to expand its staff of full-time field specialists and engineers to handle the upswing of this type of completion.

Much has changed. Completions that once presented problems and seemed impractical are now considered routine due to Axelson's experience and advanced engineering design. Past complexities have been simplified and Axelson's know-how, specialized equipment and experience are available to all. Axelson's Two-Zone Department, now called Special Products Department, covers every multiple zone producing field in the United States and deals with both new completions and existing installations. They are also available to make recommendations on triple completions and slim hole duals or any phase of special multiple completion engineering.

Although their primary function is designing setups for multiple zone completions to take advantage of the production economies afforded by Axelson Two-Zone Pumps, Axelson experts work out production problems and make recommendations where one zone may be producing gas and the other oil, or where one zone is flowing and the other is pumping.

Axelson Two-Zone Pumps provide a practical, economical method of producing from two zones at once without commingling the fluids. Only one surface pumping unit is required, with a single rod string. All pump parts, with the exception of the cross-over assemblies, are standard, field proved parts, and the Two-Zone Pump itself is an insert-type pump, completely retrievable. A metal-to-metal seal is used for long life and dependability.

While the pumps themselves might be termed standard units, no multiple-zone completion can be called standard. No two wells present the same conditions, so each Axelson dual zone installation is in effect custom designed.

When an Axelson two-zone specialist is called in to discuss a multiple zone installation, he takes into account: pump depth (for both zones), casing size and length, tubing, water cut, gravity of the oil, desired production and the gas/oil ratio. The surface pumping unit—peak load and torque ratings, stroke length and maximum cycle, size—also enters the calculations, as well as such special conditions as sand, viscous fluid, and corrosion. He can also recommend the best tubing string design, the prime mover, surface pumping unit, packer type and rod string.

When the installation is made, he will supervise it at no extra charge—set the pumps and packers, and be on hand for the initial pump running—to make sure you have an efficient, economical production setup.

Call in your Axelson specialist and let him work with you in engineering your multiple zone installations. If you are contemplating a multiple zone flowing well, the Axelson specialist can install the correct cross-over now—and you won't have to pull tubing when you run the two-zone pump later!

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In most valuation problems, particularly during the period of primary production, operating costs may be related directly to predicted production on the basis of a cents per barrel calculation. If significant cost variations toward the end of the life of the reserve are anticipated, or if it is desired to indicate the effect of the higher cost of secondary-recovery operations, the calculation time periods may be adjusted so that different cents per barrel figures of cost can be used for appropriate periods of time. Again, this involves separate solutions of the total valuation equation. It is possible also to relate these costs on a dollar per well day basis rather than a cents per barrel basis, but this complicates the equation and is normally not required as long as some cognizance is given to the relative time periods during which individual cents per barrel values are employed.

If a constant cents per barrel value is used, the operating cost in any year n is simply:

$$O_n = P_n \alpha \qquad (3)$$

Where:

O_n = annual operating cost in year n.
α = the cents per bbl. cost.

At this point, we have very simple expressions for annual production and cost. Similarly, the remaining economic factors may be expressed algebraically with no difficulty. Usual industry practice seems to be to hold price constant at initial levels through the productive life of the reserve. In this case, of course, the direct combination of the above factors to give estimated total net income in any one year can be made immediately.

$$N_n = P_n V - P_n = P(V-\alpha)(1-d)^n \qquad (4)$$

Where:

N_n = total net income in any year n.
V = the estimated price dollars per bbl.

Total net income **after** tax may be developed next as:

$$NT_n = N_n - F(N_n - 0.275\, G_n) \qquad (5)$$

Where:

F = federal income tax.
NT_n = total net income in year n after tax.

G = gross in year n = $1/0.9\ N_n$ if $\alpha = 10\%$ V.

If $F = 52\%$; NT_n
$= N_n - 0.52\,(N_n - (0.275)(1.1)\,N_n)$
$= N_n - 0.52\,N + 0.16\,N = 0.64\,N_n$

If cost depletion is appropriate, or if 50% of net limitation is effective, the depletion provided by 27.5% of gross income must be adjusted to the other

proper values. Also, if operating cost is not about 10% of price, a different factor for G in terms of N_n will be used.

At this point in the discussion we have developed very basic algebra to define net income after tax over the life of the reserve in question. The next problem is the question of interest discount to determine present value. Mathematically, this may be stated as:

$$PW_n = NT_n\, 1/(1+i)n \qquad (6)$$

Where:

PW_n = total after tax PW value in year n ($).

Now, if $PW_n = NT_n\, 1/(1+i)^n$

then, from Equations 4 and 5, PW_n
$= 0.64\,P\,(V-\alpha)\,(1-d)^n/(1+i)^n$
$= 0.64P\,(V-.1V)\,(1-d)^n/(1+i)^n$

(remembering that α has been set at 10% V.)

$$= 0.58\,PV\,(1-d)^n/(1+i)^n$$

If we set $(1-d)/(1+i) = c \qquad (7)$
$PW_n = 0.58\,PVc^n$

This may be integrated between any limits of n:

$$PW = 0.58\,PV_a{}^n{}_c n \qquad (8)$$

$$= 0.58\,PV_a{}^t \frac{c^t}{\log_e c}$$

$$= \frac{-0.58\,TV\,(1-c^t)}{\log_e c}$$

Thus, using this simple algebraic expression, and knowing price, depletion rate, interest rate, and initial production, the total, **after tax,** present value of the reserve may be computed in a matter of minutes.

If operating-cost factors or tax rates are appreciably different from those used in the derivation, adjustments of the appropriate constants may be made, or the life of the reserve may be broken into two or three parts which, after calculation, may be totaled. The capital cost I_T may be computed separately if found to be significant and its present value developed as in Equation 2. Its **after tax** value to be deducted will be approximately:

$$I_T = I - F\,(0.70\,I) = 0.64\,I, \qquad (9)$$

Where I_T = discounted, **after tax,** investment and, the estimated per cent of tax-deductible costs determines the multiplier (here 70%) for tax purposes. If significant, a depreciation factor may be inserted here, but usually this will have very little effect on the final result.

Final equation. The complete equation for valuation is, then:

$$PW_T = \frac{-0.58\,PV\,(1-c^n)}{\log_e c} - I^T \qquad (10)$$

Example problem. As an illustration, let us determine the present-worth dollar value of 10 years of productive life of a reserve whose initial production is 1,000,000 bbl. per year of $3.00 oil. Assume, as in the above derived factors, operating cost equal to about 10% of gross value, or 30 cents and assume wells are already drilled. Depletion is at 10%, present value is desired at 8%.

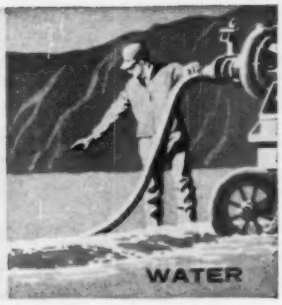
In this case, c

$$= \frac{(1-d)}{(1+i)} = \frac{1-0.1}{1+0.08} = \frac{0.9}{1.08} = 0.83$$

$$PW_T = \frac{-0.58\,(1\times10^6)\,(\$3)\,[1-(0.83)^{10}]}{\log_e\ 0.83}$$

$$= \frac{-1.74\times10^6\,(0.839)}{-0.182} = \$8.1\times10^6$$

This is within 5% of the answer obtained by laborious, year-by-year calculations in the usual manner and is certainly adequate in the light of realistic appraisal of the various unknowns present in any valuation problem. (For comparison, the detailed calculation is presented as Table 1, using initial rate and full discount for



BOSTON HOSE...

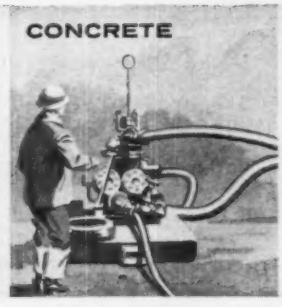


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TABLE 1—DETAILED CALCULATIONS FOR NORMAL YEAR-BY-YEAR EVALUATION OF A PRODUCING PROPERTY.

I NORMAL CALCULATION

Year	T (bbl./yr.)	V − 0 ($)	N ($) Net before tax	N_T ($)* Net after tax	Present work 8% ($)
1	1,000,000	2.70	2,700,000	1,728,000	1,600,000
2	900,000	2.70	2,430,000	1,555,000	1,333,000
3	810,000	2.70	2,187,000	1,400,000	1,111,000
4	729,000	2.70	1,968,000	1,260,000	926,000
5	656,000	2.70	1,771,000	1,133,000	771,000
6	591,000	2.70	1,596,000	1,021,000	643,000
7	531,000	2.70	1,434,000	918,000	536,000
8	478,000	2.70	1,291,000	826,000	446,000
9	430,000	2.70	1,161,000	743,000	372,000
10	387,000	2.70	1,045,000	669,000	310,000
	6,512,000		17,583,000	11,253,000	8,048,000

*$N_T = N - 0.52\ (N - 0.275\ (N + 0.1\ N)$
$N_T = N - 0.52\ (N - 0.30\ N)$
$N_T = N - 0.36\ N = 0.64\ N.$

NOTE: $N + 0.1\ N$ = assumed approximate gross value.

each year. Thus, the table is slightly in error in relation to use of midpoint values.)

There are many variations of this approach which may be used with individual problems, but in each case the benefit is clear—major savings of valuable time for application elsewhere. In all cases, accuracy is within 5% of the value as compiled in detail and normally is considered closer than this.

Discussion and conclusion. There is an understandable tendency to demand precise calculation when determining the value of a reserve. After all, this value may be the basis of a sale or purchase; the security for financing arrangements; or one of the deciding factors in the decision to invest money in development or exploration.

The serious questions affecting this desired accuracy must not be overlooked, however. Future price and the problem of proper interest rates, for example, are both variables whose investigation is often conducted quite cursorily. Future production estimates are subject to considerable error—often made even greater by the decisions of state regulatory agencies. Tax rates and procedures change and new techniques come along to alter cost predictions.

Thus, if we are honest with ourselves, the reserve valuation is only a judgment a p p r a i s a l—a trained "guesstimate." Probably the fairest evaluation is a bracketing procedure showing the reasonable range in which the actual answer probably lies. Taken from this point of view, the short-form calculation of value presented here is adaptable to a remarkable number of situations.

Several points should be kept in mind when using it.

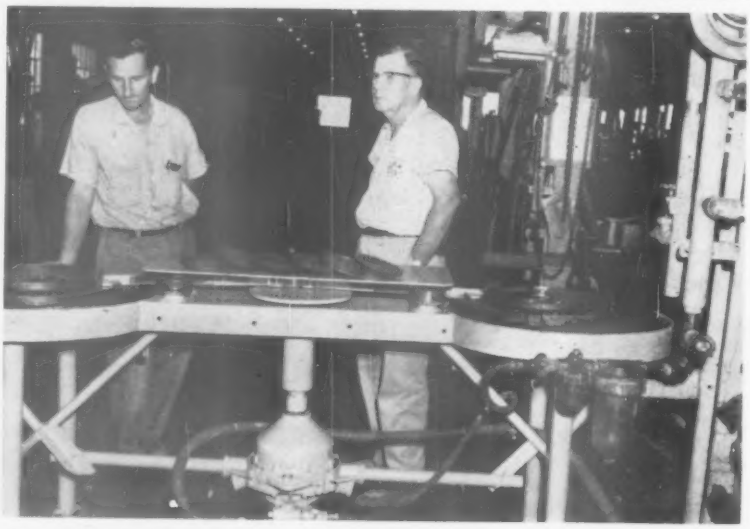
1. What is the valuation for? Factors should be chosen after careful thought about the end use of the calculation. What elements are most important? What are the data limits? How long a period of time is involved? What are the likely economic conditions?

2. This derivation sets a fixed cost/price ratio at 10%. Is this close enough for the work at hand or should the multiplier be changed? Similarly, should the tax factors be changed—or the constant price? If a change in the constant price assumption is desired, methods can be used to achieve the proper results. Either the calculation can be made in different time segments with different prices, or a constant price increase or decrease on a percentage basis can be included in the c term in the equation.

3. Is a constant per cent decline of production a reasonable profile of future conditions? If not, can the problem be broken into two or three segments with different decline?

4. If the valuation is broken into two or three segments, should different economic factors be used in each? This may readily be done and is a useful way to evaluate the effect of some of the questions in item one above.

These and similar questions point up the attractiveness of the short-form calculation since answers to many of them would have to be ignored if each answer required a full, year-by-year, computation. The analyst's emphasis can be on the engineering and economic problems and, since answers are readily available, he can afford to look at the effect of varying conditions before forming his decisions.



Shop-built lapping machine at Republic Oil Refining Co., Texas City, Tex., uses a surplus air-driven tube rolling motor as the driver. In addition to the driver many of the other parts were obtained from salvage by the designer, C. L. Vickers, shop supervisor, shown at right in photo. He was assisted by H. O. Ware, also in photo.

The cost of the finished lapping machine was much less than that of a similar factory-made unit. The tool is used for lapping compressor valves, gate-valve wedges, and other parts that need a smooth surface.

Vickers also has built several other tools using salvage materials and his ingenuity. One tool used salvaged automobile transmissions to power a variable-speed rotating table for a radial drill press. In another tool, used to lap valve parts, a steam reciprocating pump was converted to air operation and used as the driver.

MANNESMANN

The Mannesmann product list for the oil industry includes the following items

BY W. L. NELSON
Technical Editor and
Petroleum Consultant

How boiling range affects cracking yields

We hear general remarks about the uselessness of low-boiling materials as catalytic charge stocks. Can you give us definite information? Wm. T.R.

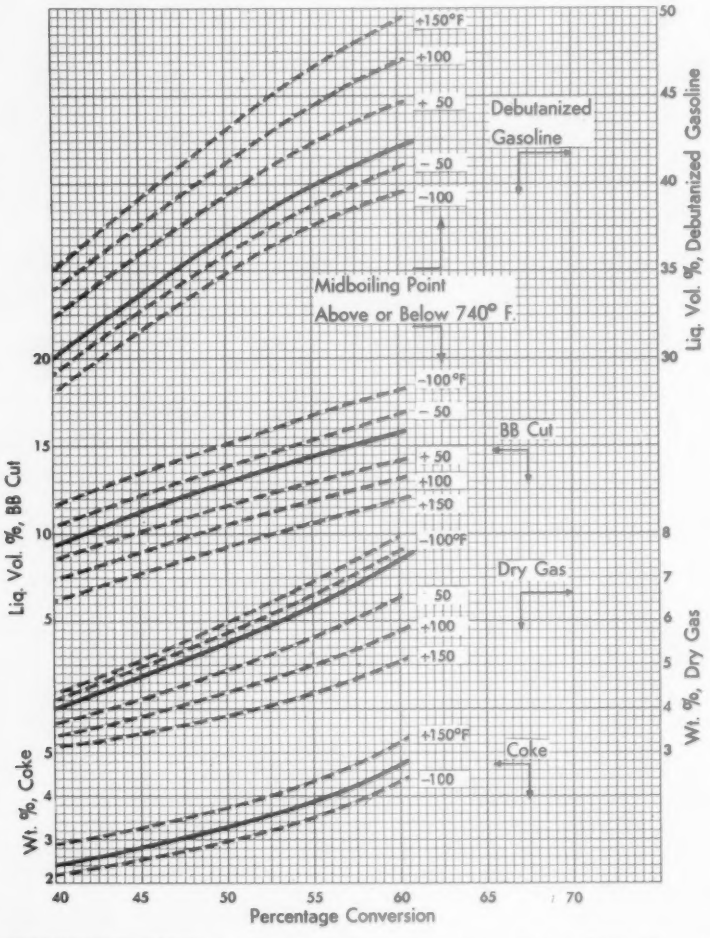
So many factors are involved in yields, especially operating conditions that are not independent variables, that only generalities can be stated. The interrelations of these many variables is bewildering to almost everyone.

The operating conditions used in catalytic cracking are always a compromise. These conditions are selected to give a severity that will adequately crack the highest-boiling portions of the feed stock without the production of excessive coke or dry gas. The highest-boiling materials in the feed are easily cracked whereas the lower-boiling materials are somewhat refractory. This is clearly indicated in Fig. 21-2, page 765 of the fourth edition of Petroleum Refinery Engineering (McGraw-Hill Book Co., Inc., N. Y., 1958). Thus, when we hear that low-boiling feed stocks are of little value in catalytic cracking we really mean that our plants have not been designed for the cracking of low-boiling materials (or the operating conditions are not suitable for low-boiling materials).

Scarcely any information relating specifically to this subject is available. However, Fig. 1 indicates the general situation. Change in midboiling point has a consistent effect except with regard to coke deposition. Narrow-boiling-range feeds, even though they have midboiling points up to about 825° F., produce smaller coke depositions than a normal wide-range 740° F. midboiling feed stock. Fig. 1 is based generally on Fig. 21-3, page 768 of Petroleum Refinery Engineering which contemplates an 11.8-12.0 characterization factor and a wide-boiling-range feed having a midboiling point of about 740° F. Note especially that somewhat different yields are obtained in the fluid and moving-bed processes:

	Fluid	Moving-bed
Coke	11-14% more	7-10% less
Dry gas	6- 9% more	6- 9% less
B-B cut	7-14% less	7-12% more
Gasoline	same	same

Yields when recycling are thought to behave in somewhat the same way as the yields of Fig. 1 which is for once-through operation, but greater differences due to boiling range would be expected.



APPROXIMATE EFFECT of boiling range on cracking yields. (Once-through operation). Fig. 1.

What's the value of steam

I see very different costs for steam in the literature. What is a proper price? G. H. M.

This subject was discussed completely in Process Costimating issues, Nos. 17 and 18 (June 23, 1958, p. 137, and June 30, 1958, p. 103). Although the literature (47 statements) indicates a wide range of values, if these are converted to the year 1958 for comparison, the average price is about 59 cents per 1,000 lb. The range in price was about as follows:

35 cents and lower	19%
36 to 45 cents	17
46 to 70 cents	38
71 to 92 cents	13
93 cents and higher	13

Variations in fuel cost are the major reason for the range as well as the extent to which the steam is reused as exhaust steam. In addition, the costs for labor, maintenance, and financial charges are sometimes neglected in estimating the cost of steam.

Monthly Report on PIPELINE CONSTRUCTION

PIPELINE ACTIVITY reported here is compiled from surveys by The Oil and Gas Journal among pipeline companies and construction contractors.

This summary report appears in the last issue of the Journal each month. New construction projects are reported weekly in Pipeline Briefs in the Journal's news section.

Projects are listed in three groups—U. S., Canadian, and Foreign—and according to type of line—crude, products, or natural gas.

★ The star symbol indicates the first appearance of the project in the Journal's survey.

U. S. Crude Oil Pipelines

Belle Fourche Pipeline Co., Box 1612, Casper, Wyo.

★ Project: 103-mile 8-in. line from Fiddler Creek field to Lance Creek, Wyo., and other lines to serve Roset, Miller Creek, and Lone Tree fields.

Status: Pending approval of Wyoming Public Service Commission.

Cape Pipe Line Co. (Sun Oil Co., Cities Service Co., Atlantic Refining Co.), Philadelphia.

Project: Line from lower Delaware Bay to Philadelphia.

Status: Planned.

Cooperative Refinery Association, Kansas City, Mo.

Project: 6 miles of 6-in. at Stockton, Kans.

Status: Planned.

Completion: Spring 1960.

Gillette Pipeline, Inc., and **A. W. Hartwig, Inc.**

Project: A 102-mile line from Dead Horse Creek field to Casper, Wyo.

Status: Pending Wyoming Public Service Commission approval.

International Oil Pipeline Corp., New York City.

Project: Would own U. S. section of 1,500-mile, 30-in. line proposed by Mid-Continent Pipe Lines, Ltd., from Edmonton, Alta., to Chicago. (See Canadian Crude-Oil Pipelines).

Status: Proposed.

International Refineries, Inc., 227 North Colfax Avenue, Minneapolis, Minn., and **Barron Kidd,** Dallas, Tex.

★ Project: Crude-gathering system in Wiley field, Bottineau County, North Dakota.

Status: Planned.

Matador Pipe Line Corp., Denver, Colo.

Project: 175-mile line to carry crude from Burke, Bottineau, and Renville counties, North Dakota, to Cromer, Man., where it would tie in with the Interprovincial pipeline.

Status: Proposed. Representatives of Western Crude Marketers, Inc., Denver, have been conducting feasibility studies in North Dakota. Matador's application is pending before the Canadian Parliament.

Completion: Tentatively early summer 1960.

Shell Pipe Line Corp., Box 2648, Houston, Tex.

★ Project: 32½ miles of 2 to 6-in. gathering lines.

Status: Planned.

Completion: 1960.

Standard Oil Co. of California, San Francisco.

Project: 22 miles of 8-in. from Swanson River Unit on Kenai Peninsula to Nikiski on Cook Inlet, Alaska.

Status: Planned.

U. S. Products Pipelines

Farmers Union Central Exchange, Inc., Box G, St. Paul 1, Minn.

★ Project: 200 miles of 8-in. from Glendive, Mont., to Minot, N. D.

Status: Proposed.

Humble Oil & Refining Co., Houston.

Project: About 34 miles of 4-in. line to move propylene from Baytown refinery to petrochemical plant at Texas City.

Humble Pipe Line Co., Box 2220, Houston 1, Tex.

★ Project: 27 miles of 10-in. from Baytown to Houston.

Contractor: **Golightly Construction Corp.,** Houston, Tex.

Completion: April 15, 1960.

Husky Oil Co., Cody, Wyo.

Project: About 100 miles from Cody to the Yellowstone products line west from Billings, Mont.

Status: Planned.

Completion: Late 1960.

Mid-America Pipeline Co., (Missouri-Kansas-Texas Railroad), New York.

Project: 2,500-mile LPG system from West Texas-New Mexico area to upper Midwest. Main line would be 1,500 miles, with extensive gathering systems, to connect gasoline plants in West Texas, southeastern New Mexico, and Texas Panhandle. The line from the Southwest would fork at McPherson, Kans., with one branch going to Minneapolis and the other to Madison, Wis. Size of pipe would be 8 and 10-in. with branches 6 to 8-in.

Status: Planned. Project may be started in April 1960.

Contractor: **Williams Brothers Co.,** Tulsa, has engineering, management, and construction.

Completion: Fall 1960.

Seadrift Pipeline Corp. (subsidiary of Union Carbide Corp.).

★ Project: 108 miles of line from Union Carbide's Seadrift, Tex., plant, to Humble Oil & Refining Co.'s King Ranch plant at Ella, Tex.

Status: Planned.

Contractor: **Pipe Line Technologists, Inc.,** Houston, has contract for engineering and construction supervision.

Texas Pipe Line Co., 1111 Rusk Avenue, Houston, Tex.

★ Project: 42 miles of 6-in. LPG line from the New Hope natural-gasoline plant in Franklin County, Texas, to the Nettleton station.

Status: Planned.

Completion: June 1960.

U. S. Natural Gas Pipelines

Anchorage Gas Corp., Houston.

Project: 165 miles of line at least 12-in. in diameter from Kenai Peninsula to Anchorage.

Status: Planned. Construction may start late April or early May 1960.

Arkansas Industrial Pipeline Corp. (Arkansas Louisiana Gas Co.), Shreveport, La.

Project: 130 miles of 18-in. from Perla to Helena, Ark.

Status: Planned.

Completion: 1960.

Arkansas Louisiana Gas Co., Shreveport, La.

Project: About 58 miles of 2, 3, 4, and 6-in. line in various locations.

Status: Planned.

Completion: 1960.

Atlantic Seaboard Corp., Box 1273, Charleston, W. Va.

Project: 43 miles of 20-in. line from the Seneca compressor station in Pendleton County to the Terra Alta storage project in Preston County, West Virginia.

Status: Temporary authority granted by FPC.

Carolina Pipeline Co., Columbia, S. C.

Project: 85 miles of 8-in. in South Carolina.

Status: Pending FPC approval.

Central Hudson Gas & Electric Corp., South Road, Poughkeepsie, N. Y.

Project: 16 miles of 10-in. from Sleightsburg to Highland, N. Y.

Status: Under way.

Contractor: **C. N. Flagg & Co.,** Meriden, Conn.

Completion: September 1960.

Cities Service Gas Co., Box 1995, Oklahoma City 1, Okla.

★ Project: 13 miles of 16-in. from Alden field, Rice County, Kansas, to the company's Lyons station; 10 miles between Lyons and Hutchinson; and 9 miles near Wichita.

Status: Pending FPC approval.

Completion: By fall 1960.

Coastal States Gas Producing Co., Corpus Christi, Tex.

Project: 60 mile sof 10-in. in La Salle and Frio counties, Texas.

Status: Planned.

Completion: June 1960.

Coastal Transmission Corp., Houston.

Project: 65 miles of 3, 4, 6, and 10-in. in Texas and Louisiana.

Status: Pending before FPC.

Completion: Summer 1960.

Colorado Interstate Gas Co., Box 1087, Colorado Springs, Colo.

★ Project: 7 miles of 20-in. in Texas Panhandle.

Status: Pending FPC approval.

Completion: 1960.

Project: 109 miles of 26-in. from Four-Way station in Texas Panhandle, to Morton Junction in southeastern Colorado; 135 miles of 34-in. from there to Pueblo, and 107 miles of 30-in. on to Denver; 155 miles of 34-in. from CIG line at Rock Springs, Wyo., to Provo, Utah, to connect with proposed El Paso Natural Gas Co.'s line to California.

Status: Pending FPC approval.

Completion: 1960.

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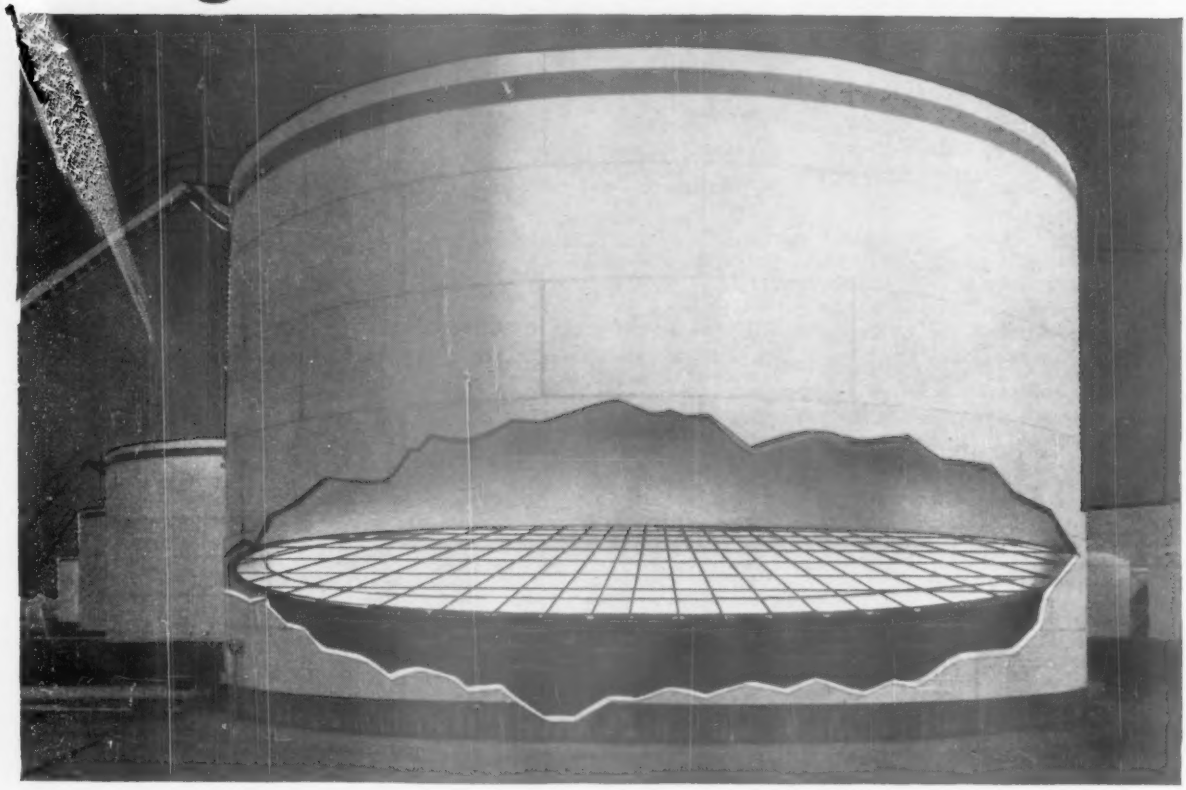

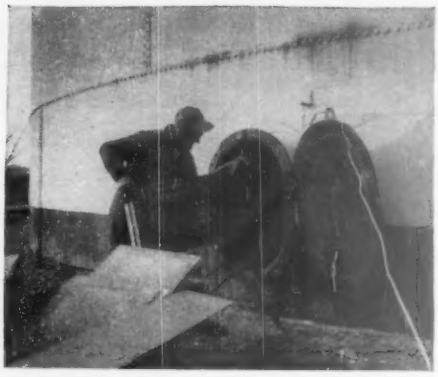

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PIPELINE CONSTRUCTION

Project: 32 miles of 6-in. from Central Colorado to Trinidad.
Status: Pending FPC approval.
Completion: 1960.
Colorado Oil & Gas Corp., Denver.

Project: 402-mile line from Gubik field to Fairbanks, Alaska.
Status: Proposed.
Colorado-Wyoming Gas Co., Box 480, Denver 1, Colo.

★ Project: 4 miles of 3½-in. from main line to Erie, Colo.
Status: Planned.
Completion: August 1960.
Columbia Gulf Transmission Co., Box 1916, Houston, Tex.

★ Project: 6 miles of 24 and 30-in. at Mississippi River crossing near Providence, La.
Status: Pending FPC approval.
Completion: November 1, 1960.
Consumers Power Co., 212 West Michigan Avenue, Jackson, Mich.

★ Project: 7 miles of 16-in. from Salem field to Overisel field, Allegan County, Michigan.
Status: Proposed.
Completion: May 1, 1960.

Project: 121 miles of 26-in. from the Indiana - Michigan border to Northville, Mich., and 22 miles of 24-in. from Northville to Clarkston, Mich.
Status: Under way.
Contractor: **Cape Construction Co., Inc.,** Cape Girardeau, Mo.
Completion: April 1960.
El Paso Natural Gas Co., Box 1492, El Paso, Tex.

Project: 19 miles of 20-in., 40½ miles of 16-in., 26 miles of 12-in., and 36 miles of 10-in. from existing 26-in. main line in Cowlitz County, Washington, to Eugene, Ore.
Status: Under way.
Contractors: **Hood Construction Co.,** Whittier, Calif., and **River Construction Corp.,** Fort Worth, Tex.

Project: 64 miles of various small-diameter gathering line in Beaver and Ellis counties, Oklahoma, and Hemphill, Lipscomb, and Ochiltree counties, Texas.
Status: Approved by FPC.

Project: 39 miles of gathering line in the East Maljamar and Kemnitz areas, Lea County, New Mexico.
Status: Approved.

Project: 17 miles of 5-in. lateral from an interconnection with Pacific Gas Transmission Co.'s proposed 36-in. line in Klamath County to near Klamath Falls, Ore.
Status: Pending FPC approval.

Project: 34.2 miles of 20-in. from Puckett, Tex., to Goldsmith plant; 51.3 miles of 20-in. from Terrell to Puckett Plant discharge; and 23 miles of 20-in. from Goldsmith to Eunice-Dumas line.
Status: Pending FPC approval.

Project: 244 miles of 30-in. Permian-San Juan Line loops.
Status: Under way.
Contractor: **R. H. Fulton & Co.,** Lubbock, Tex., has contract for 126 miles in New Mexico, with office in Tatum, N. M.

Project: 395 miles of 34-in. from Salt Lake City, to California border near Las Vegas, Nev.
Status: Pending FPC approval.
Completion: January 1, 1961.
Emerald Corp., Box 631, Amarillo, Tex.

★ Project: 49 miles of 20-in. from Shamrock Oil & Gas Corp's McKee plant to Amarillo, Tex.
Contractor: **Vaughn & Taylor Construction, Inc.,** Odessa, Tex.
Completion: April 1960.

★ Project: 54½ miles of 16-in., 5½ miles of 20-in., and 20 miles of 2 and 4-in. from east central Ochiltree County, Texas, to

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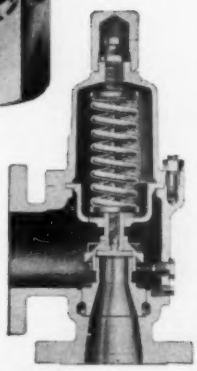
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PIPELINE CONSTRUCTION

Shamrock Oil & Gas Corp.'s Stewart compressor.
Status: Under way.
Contractor: **Vaughn & Taylor Construction Co., Inc.,** Odessa, Tex.
Completion: June 1960.

Equitable Gas Co., 420 Boulevard of the Allies, Pittsburgh, Pa.
Project: 58 miles of 16 and 20-in. from Marion County, West Virginia, to Washington County, Pennsylvania.
Status: Pending FPC approval.
Completion: Fall 1960.
Project: 17 miles of 16-in. in Marion and Monangalia counties, West Virginia.
Status: Temporarily approved by FPC.
Contractor: **Joyce Pipeline Co.,** Andover, N. Y.
Completion: October 31, 1960.
Project: 3½ miles of 20-in. in Green County, Pennsylvania.
Status: Temporarily approved by FPC.
Contractor: **Joyce Pipeline Co.,** Andover, N. Y.
Completion: October 31, 1960.

Gulf Resources, Inc., New York.
Project: 136 miles of 14 and 20-in. from Hidalgo County to LaSalle County, Texas.
Status: Pending FPC approval.

Hope Natural Gas Co., Clarksburg, W. Va.
Project: 20 miles of 24-in. line in Wetzel and Monongalia counties, West Virginia, replacing two 16-in. lines.
Status: Approved.

Houston Pipe Line Co., Box 2412, Houston, Tex.
★ Project: 35 miles of 18-in. from Sheridan to Wharton, Tex., in the Houston area.
Status: Planned.
Contractor: **Sheppard-Geiger Construction Co.,** Corpus Christi, Tex.

Houston Texas Gas & Oil Corp., Box 10400, St. Petersburg 33, Fla.
Project: 270 miles of 2 to 6-in. lateral lines.
Status: Pending FPC approval.

Iron Ranges Natural Gas Co., St. Paul.
Project: 79 miles of 10 and 12-in. from Grand Rapids to Hoyt Lake, Minn., and 67 miles of 12-in. from Duluth to Silver Bay, Minn.
Status: Approved by FPC.
Completion: 1960.

Iroquois Gas Co.
Project: 9.5 miles of 16-in. in Erie County, New York.
Status: Pending FPC approval.

Kansas-Nebraska Natural Gas Co., Inc., Phillipsburg, Kans.
★ Project: Enlargement of gathering facilities in Kansas' Hugoton field, including 10 miles of 8-in., 10 miles of 20-in., and about 2 miles of 26 and 30-in.
Completion: August 1, 1960.
★ Project: 15 miles of 4-in. from Kimball, Neb., to a gathering line north of Kimball.
Completion: July 1, 1960.
★ Project: 56 miles of 2-in. to serve several communities in Kansas.
Completion: September 1, 1960.

Laclede Gas Co., St. Louis, Mo.
Project: 107 miles of 24-in. between Hallsville, and St. Louis, Mo.
Status: Proposed.

Lone Star Gas Co., Dallas, Tex.
Project: 40 miles of 12-in. in Eastland and Callahan counties, Texas.
Contractor: Company crews.
Completion: May 1, 1960.

Manufacturers Light & Heat Co., Union Trust Building, Pittsburgh 19, Pa.
Project: 66 miles of 20-in. from Abbottstown to the Fulton-Franklin county line in Pennsylvania.
Status: Planned.
Completion: October 1960.

PIPELINE CONSTRUCTION

Project: About 21 miles of 20-in. in Fayette County, Pennsylvania.
Status: Planned.
Completion: October 1960.
Project: 5 miles of 20-in. in Monongalia County, West Virginia.
Status: Planned.
Completion: October 1960.
Michigan Wisconsin Pipe Line Co., 500 Griswold Street, Detroit 26, Mich.
Project: 342 miles of 24-in. and 188 miles of 30-in. main-line loop.
Status: Pending FPC approval.
Completion: September 1, 1960.
Project: 9 miles of 6-in., 17 miles of 8-in., and 11 miles of 12-in. lateral loops in Wisconsin.
Status: Pending FPC approval.
Completion: September 1, 1960.
Project: 69 miles of 24-in., 28 miles of 20-in., 96 miles of 16-in., and 118 miles of 4 to 8-in. in Wisconsin.
Status: Conditionally approved by FPC.
Completion: November 1, 1960.
Project: 29 miles of 30-in. main-line loops.
Status: Pending FPC approval.
Completion: November 1, 1960.
Midwestern Gas Transmission Co., Houston.
Project: 504 miles of 24-in. from Emerson, Man., to Marshfield, Wis., plus 54 miles of sales laterals.
Status: Approved by FPC, subject to issuance of a Canadian export permit for Trans-Canada Pipe Lines, Ltd., to deliver gas to Midwestern. A decision by the National Energy Board of Canada on Trans-Canada's export application is pending.
Completion: 1960.
Mississippi River Fuel Corp., 407 North 8th Street, St. Louis 1, Mo.
★ Project: 5 miles of 16-in. and 15 miles of 12-in. from Collinsville, Ill., to St. Jacob, Ill.
Status: Pending FPC approval.
Mississippi River Transmission Corp. (Mississippi River Fuel Corp.), St. Louis.
Project: 115 miles of 24-in. from near Oran in southeast Missouri, north between Ste. Genevieve and Bonne Terre into vicinity of Herculaneum and Pevely then into St. Louis County.
Status: Planned.
Completion: Last half 1960.
Mountain Fuel Supply Co., 180 East 1st South Street, Salt Lake City, Utah.
★ Project: 7 miles of 24-in. from Mountain Dell to Salt Lake City's Sunnyside station.
Status: Proposed.
Completion: 1960.
★ Project: 6 miles of 20-in. from Kanda Junction to Green River, Wyo.
Status: Proposed.
Completion: 1960.
Natural Gas Gathering Co., Inc., Corrigan Tower, Dallas, Tex., and **Gulf Resources, Inc.**
★ Project: 31 miles of 10, 12, and 14-in. in Zapata and Starr counties, Texas.
Status: Pending FPC approval.
Completion: Fall 1960.
Natural Gas Pipeline Co. of America, 122 South Michigan Avenue, Chicago Ill.
★ Project: 5 miles of 8-in. in Grady County, Oklahoma.
Status: Pending FPC approval.
★ Project: About 18 miles of 4 to 10-in. gathering lines in Carson County, Texas.
Status: Pending FPC approval.
Project: 151 miles of 36-in. intermittent sections paralleling mainline facilities between Ford County, Kansas, and Joliet, Ill.
Status: Pending FPC approval.
Project: 180 miles of 24-in. between Kiowa County, Oklahoma, and Minneola, Kans.
Status: Pending FPC approval.
Natural Gas Storage Co. of Illinois, 122

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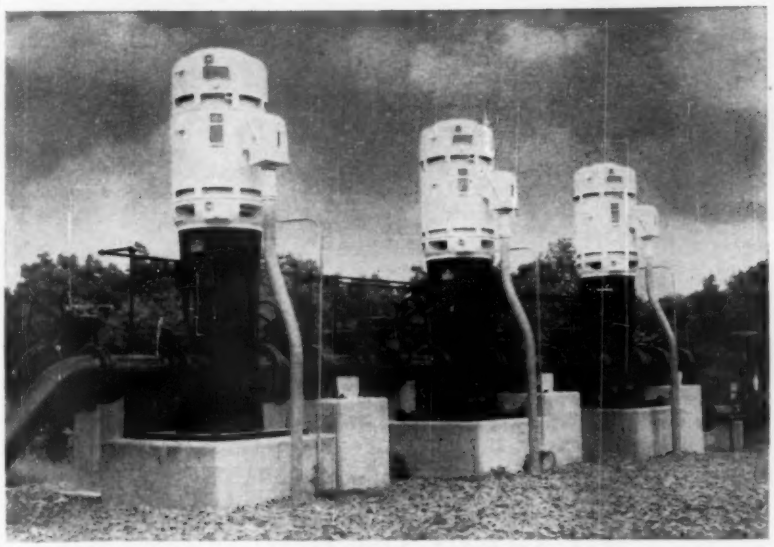

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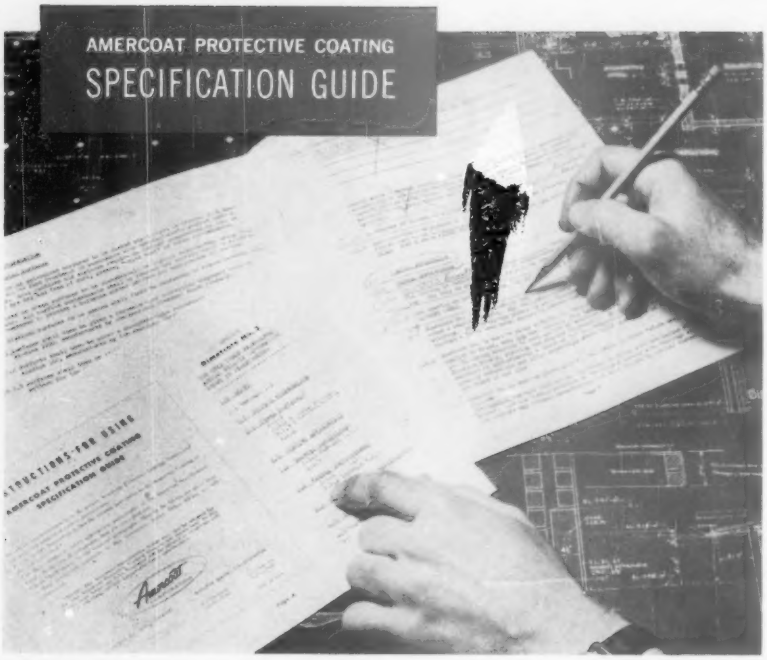

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PIPELINE CONSTRUCTION

South Michigan Avenue, Chicago 3, Ill.

★ Project: About a third of a mile of 10-in. and about a half mile of 20 and 24-in. at storage facilities in Kankakee County, Illinois.

Completion: August 15, 1960.

★ Project: About a half mile of 36-in. Illinois River crossing.

Status: Pending FPC approval.

Completion: September 23, 1960.

Niagara Mohawk Power Corp., Syracuse, N. Y.

Project: 104 miles of 12-in. from Watertown, N. Y., to Massena, N. Y.

Contractor: **Fulghum Contracting Corp.,** Harrisburg, Pa.

Northern Illinois Gas Co., 50 Fox Street, Aurora, Ill.

★ Project: 75 miles of 30-in. from underground storage at Troy Grove to the company's distribution system near LaGrange, Ill.

Status: Scheduled to start in spring 1960.

Completion: By September 1, 1960.

Northern Natural Gas Co., Omaha, Neb.

Project: 217 miles of main line, 221 miles of main-line loops, and 2,178 miles of branch lines of various diameters.

Completion: 900 miles were completed in 1959.

Project: 36.5 miles of 2 to 16-in. gathering lines at Otis gas field, Rush County, Kansas, for underground storage, and 36.7 miles of 30-in. transmission line connecting Otis storage area to main line at Bushton, Kans.

Status: Pending FPC approval. ,

Project: About 21 miles of 16-in. and 26 miles of various small diameter pipeline in the Glick field, Kansas, area in Kiowa, Comanche, and Barber counties.

Status: Pending FPC approval.

Project: 188 miles of 24-in. and 215 miles of 30-in. from Farmington, Minn., to International border.

Status: Proposed.

Project: 83 miles of 20-in. from East Dubuque, Ill., to Janesville, Wis.

Status: Pending FPC.

Completion: Fall 1960.

Ohio Oil Co., Findlay, Ohio.

Project: 28 miles of gathering line to move casinghead gas to proposed natural-gasoline plant in south central Michigan.

Status: Under way.

Contractor: **Somerville Construction Co.,** Ada, Mich.

Oklahoma Resources Development Co., Cameron Building, Oklahoma City.

Project: About 170 miles of 12-in. trunk line from Oklahoma City to Harrah and Muskogee, Okla., and about 130 miles of 4 to 12-in. lateral from the Greasy Creek area of Hughes County and from Blaine and Logan counties.

Status: Planned.

Completion: November 1, 1960.

Old Ocean Fuel Co. (subsidiary of Texas Electric Service Co.), Fort Worth, Tex.

★ Project: 364 miles of 16, 20, and 24-in. from the Gulf Coast south of Houston to the Fort Worth area.

Status: Expected to start in May 1960.

Contractors: **H. B. Zachry Co.,** San Antonio, Tex., and **O. R. Burden Construction Corp.,** Tulsa, Okla.

Completion: By late December 1960.

Pacific Gas & Electric Co., San Francisco.

Project: 120 miles of 34-in. looping of Topock-Milpitas main line.

Status: Planned. Pending FPC approval.

Completion: 1961.

Project: 11 miles of 20-in. from Pittsburg to Walnut Creek, Calif.

Contractor: Using company crews.

Completion: 1960.

Project: 296 miles of 36-in. from the Cali-

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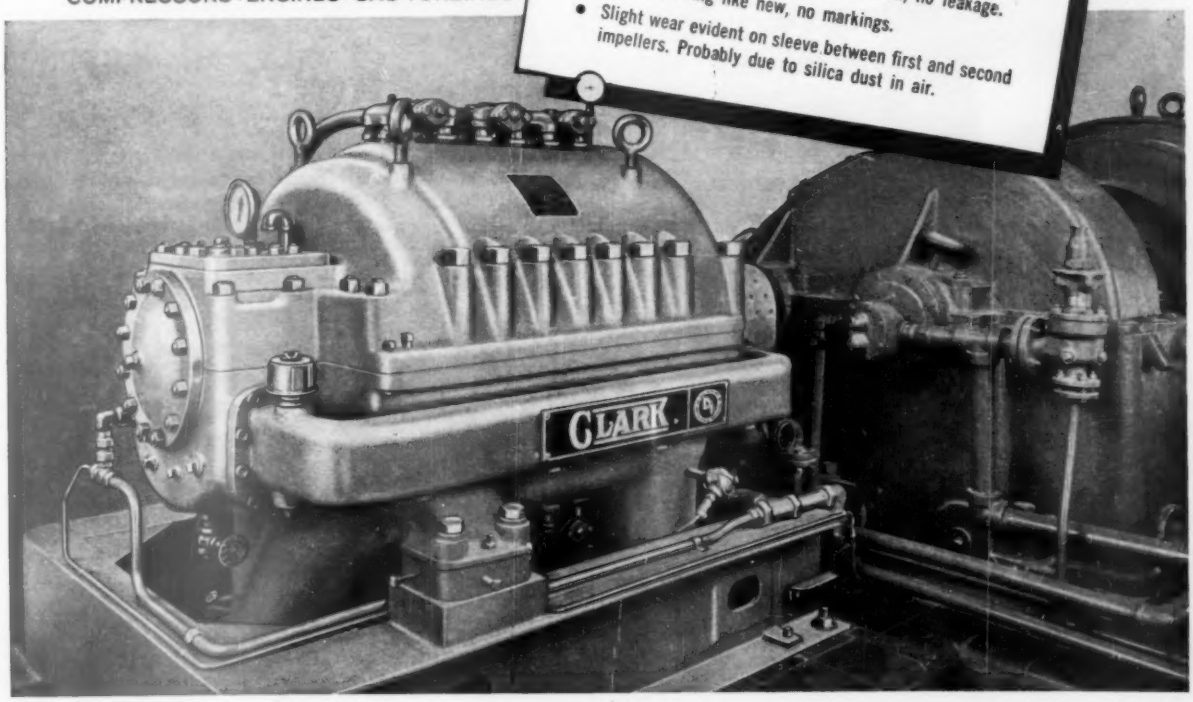

PIPELINE CONSTRUCTION

fornia-Oregon border to Antioch, Calif. (This is part of the project to import natural gas from Canada, which will include the Pacific Gas Transmission project listed below.)

Status: Pending approval from governments.

Completion: 90 miles scheduled for completion in 1960, the rest in 1961.

Pacific Gas Transmission Co. (Pacific Gas & Electric, San Francisco).

Project: 614 miles of 36-in. from Kingsgate, B. C., to California border near Klammath Falls, Ore.

Status: Pending approval of FPC and Canadian authorities to import gas.

Pacific Lighting Gas Supply Co., Los Angeles.

Project: 116 miles of 34-in. from Needles to Newberry, Calif.

Status: Under way.

Contractors: **Engineers Limited Pipeline Co.,** San Francisco, and **Pacific Pipeline Construction Co.,** Montebello, Calif. **Missouri Valley Dredging Co.,** Omaha, has contract for a dual 24-in. crossing of the Colorado River near Needles.

Completion: July 1, 1960.

Pacific Northwest Pipeline Corp., Salt Lake City, Utah.

Project: 18 miles of 20-in. and 40 miles of 16-in. from main line near Camas, Wash., to Salem, Ore.

Status: Pending before FPC.

Completion: 1960.

Project: 60 miles of 12-in. from Salem to Eugene, Ore.

Status: Planned.

Completion: 1960.

Project: 61 miles of 4, 6, and 8-in. gathering line in Big Piney field, Wyoming.

Status: Planned.

Completion: 1960.

Project: 9 miles of 12-in. gathering line in Red Wash field, Uintah County, Utah.

Status: Planned.

Completion: 1960.

Panhandle Eastern Pipe Line Co., 1221 Baltimore Avenue, Kansas City, Mo.

★ Project: 100 miles of 4 to 12-in. gathering lines.

Status: Proposed.

Contractor: **Hall Construction Co.,** Liberal, Kans.

Completion: December 31, 1960.

★ Project: 315 miles of 30-in. and 40 miles of 26-in. loops on main line.

Status: Pending FPC approval.

Completion: Fall 1960.

Peoples Gas Light & Coke Co., 122 South Michigan Avenue, Chicago 3, Ill.

★ Project: 29 miles of 36-in. between its North Shore and Calumet stations in the Chicago area.

Status: Planned.

Completion: 1960-62.

Peoples Gulf Coast Natural Gas Pipeline Co., 122 South Michigan Avenue, Chicago 3, Ill.

Project: 371 miles of 30-in. of present system between Texas and Chicago.

Status: Pending FPC approval.

Completion: November 15, 1960.

★ Project: About 59 miles of various size looping of main line in Brazoria, Galveston, Aransas, and Refugio counties, Texas.

Status: Pending FPC approval.

Completion: November 15, 1960.

Peoples Natural Gas Co., Two Gateway Center, Pittsburgh 22, Pa.

★ Project: 37 miles of 12 and 20-in. in various parts of Pennsylvania.

Status: Planned.

Contractor: **Joyce Western Corp.** has contract for 8 miles of 20-in. from Imperial to Aliquippa, Pa.

Completion: From June to October 1960 for most of the line.

Phillips Petroleum Co., Bartlesville, Okla.

Project: 17 miles of 3 to 16-in. gathering lines in central Oklahoma.

Status: Under way.

Contractor: **George W. Davis Construction Co.,** Oklahoma City.

Completion: Indefinite.

Pioneer Natural Gas Co., Amarillo, Tex.

Project: 21 miles of 12-in. from Sudan to Muleshoe, Tex.

Status: Pending FPC approval.

Project: 12 miles of 10-in. from Muleshoe, Tex., northward.

Status: Pending FPC approval.

Public Service Co. of North Carolina, Gastonia, N. C.

Project: About 47 miles of 4, 8, and 10-in. in North Carolina.

Rocky Mountain Natural Gas Co.

Project: 65 miles of gas line in southwestern Colorado to supply Collbran, Montrose, Delta, and Orchard City.

Status: Planned.

South Texas Natural Gas Gathering Co. (Coastal States Gas Producing Co., Corpus Christi, Tex.)

Project: 125 miles of 8, 10, 14, 18, and 20-in. line in Jimm Hogg County, Texas.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.,** Tulsa.

Completion: March 1960.

Southern California Gas Co., Los Angeles.

Project: 13 miles of 34-in. from San Fernando Valley (Los Angeles) to West Los Angeles.

Status: Approved.

Completion: 1960.

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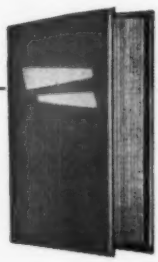

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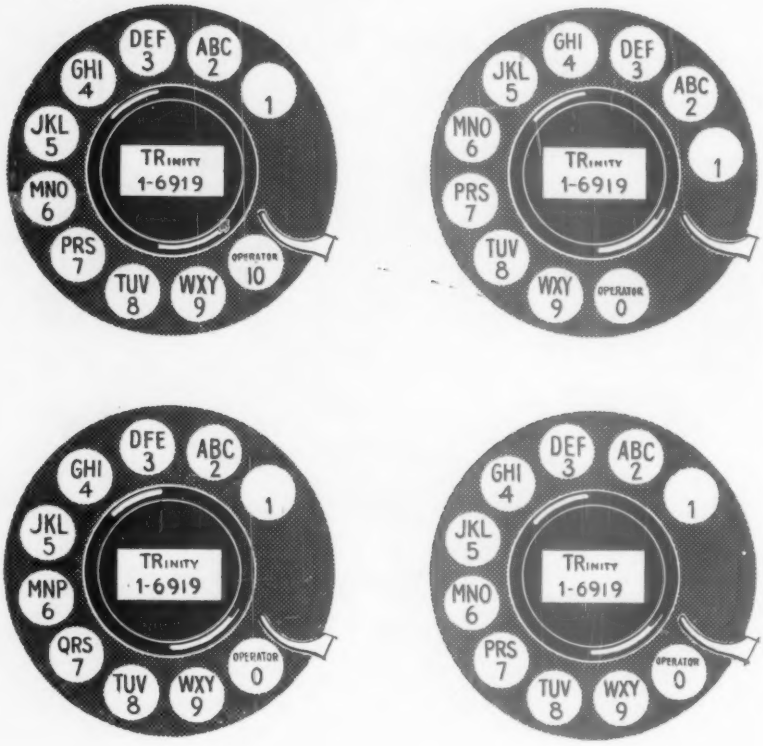

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PIPELINE CONSTRUCTION

Counties Gas Co. of California, Los Angeles.

Project: 93 miles of 34-in. from Ivanpah (near California-Nevada border) to Newberry, Calif.

Status: Pending FPC approval.

Completion: 1961.

Project: 115 miles of 36-in. from Newberry to Placentia, Calif.

Status: Under way.

Contractors: **Young & Anderson Co.,** Brea, Calif., has contract for 85 miles from Newberry to Fontana. Contractors for the remainder are **Hood Construction Co.,** Whittier, Calif.; **J. P. Neill & Co.,** Dallas; and **River Construction Corp.,** Fort Worth, Tex.

Completion: August 1960.

Tennessee Gas Pipeline Co., Box 2511, Houston, Tex.

Project: 155 miles of 30 and 36-in. loops in Ohio, Pennsylvania, and New York, and 72 miles of gathering line.

Status: Pending FPC approval.

Project: 21 miles of 16-in. gathering line from Louisiana coast to Block 46 in the Vermilion area.

Status: Pending FPC approval.

Project: 2 miles of 12-in. gathering line from Block 66 to Block 64, East Cameron area, offshore Louisiana.

Status: Pending FPC approval.

Project: 158 miles of 36-in. gas loop at various points between Kinder, La., and Centerville, Tenn.

Status: Approved by FPC.

Project: 41 miles of 30-in. loop east of Hamburg, N. Y.

Status: Pending FPC approval.

Project: 25 miles of 30-in. loop near Kane, Pa.

Status: Pending FPC approval.

Texas Eastern Transmission Corp., Shreveport, La.

Project: 85 miles of 24-in. from Tamarack, to Perulack, Pa.

Status: Pending FPC approval.

Project: 40 miles of 36-in. from Lambertville, to Linden, N. J.

Status: Pending FPC approval.

Project: 23 miles of 20-in. from Eagle, to Chester Junction, Pa.

Status: Pending FPC approval.

Project: 3 miles of 30-in. from Linden, to Staten Island, N. J.

Status: Pending FPC approval.

Project: 65 miles of 30-in. from Perulack, Pa., to Lambertville, N. J.

Status: Pending FPC approval.

Transcontinental Gas Pipe Line Corp., Houston, Tex.

Project: 69 miles of 30-in., 211 miles of 36-in., and 7 miles of 16-in. in various states.

Status: Pending FPC approval.

Completion: 1960.

Project: 83 miles of 30-in. and 152 miles of 36-in. in various states.

Contractors: **Williams Brothers Co.,** Tulsa, has contract for 23 miles of 30-in. near DeQuincy, La.; and **Panama-Williams Corp.,** Houston, has contract for 15 miles of 30-in. near Houston.

Status: Under way on 30-in. line.

Completion: 1960.

Project: 13 miles of 24-in. and 40 miles of 8 to 20-in. Louisiana purchase laterals.

Status: Approved by FPC.

Completion: 1960.

Transwestern Pipeline Co., Houston.

Project: 490 miles of 24 and 20-in. from Texas to Roswell, N. M., and 670 miles of 30-in. from Roswell to Topock, Ariz., near the California border. Also, 300 miles of 10, 12, and 16-in. lateral lines in Texas and New Mexico.

Status: Under way.

Contractors: **Houston Contracting Co.,** Houston, and **H. C. Price Co.,** Bartlesville, Okla., have joint contract to build the main

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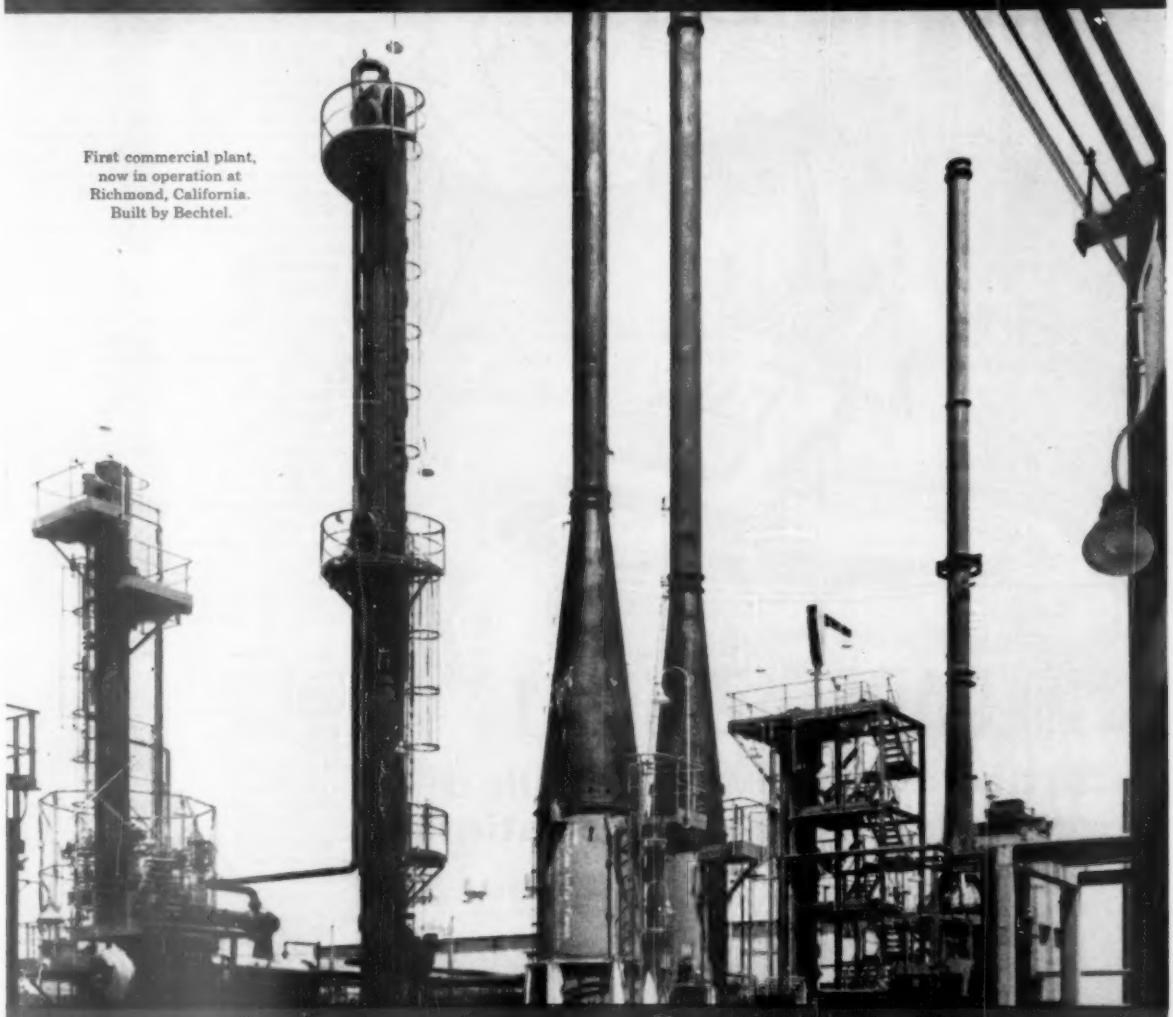

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PIPELINE CONSTRUCTION

line. Houston Contracting will build 149 miles of 30-in. from Corona, N. M., west to McCartys, N. M.; 55 miles of 30 and 89 miles of 24-in. from Corona east to Roswell and southeast to Carlsbad; 61 miles of 20 and 76 miles of 24-in. from Fort Stockton, Tex., to Carlsbad; and 166 miles of 24-in. from Roswell northeast to Dawn, Tex. Price will handle two main-line spreads totaling 335 miles in Arizona. As for the 300 miles of laterals, Houston Contracting will carry out this work with **R. H. Fulton & Co.**, Lubbock, Tex., and **Western Pipe Line, Inc.**, Austin, Tex.

Completion: June 1960.

Project: 300 miles of 4, 6, and 8-in. gathering lines in the Texas Panhandle, northwestern Oklahoma, Southwest Texas, and southeastern New Mexico. This project is in conjunction with the 1,160-mile Texas-California line (see above).

Contractor: **Sheehan Pipe Line Construction Co., Tulsa.**

Completion: June 1960.

Trunkline Gas Co., Box 1642, Houston, Tex.

Project: 252 miles of 30-in. including two loops in Louisiana, one from Mississippi into Tennessee, one from Kentucky into Illinois, and another to the Tuscola, Ill., terminus.

Status: Pending FPC approval.

Completion: Fall 1960.

Project: 140 miles of supply lateral in South Louisiana, including a 17-mile 24-in. loop of an existing lateral and 123 miles of 20, 24, and 26-in.

Status: Pending FPC approval.

Completion: Fall 1960.

Project: 24.5 miles of 12-in. gathering line from Lowry, to Cameron Parish shoreline, Louisiana.

Status: Under way.

Contractor: **Sam Carline, Inc.**, Berwick, La.

Project: 42 miles of 24-in. loop from west of Moss Hill, to Silsbee, Tex.

Status: Under way.

Contractor: **Sharman, Allen, Gay & Taylor, Inc.**, Houston.

Project: 53 miles of 30-in. loop from Pitkin, to Pollock, La.

Status: Under way.

Contractor: **Grayco Constructors, Inc.**, Austin, Tex.

Project: 61 miles of 30-in. loop from Pollock, to Riverton, La.

Status: Under way.

Contractor: **APV Co., Inc.**

Project: 177 miles of 30-in. loops in Louisiana, Arkansas, Mississippi, Tennessee, and Kentucky.

Status: Under way.

Contractor: **Panama, Inc., Houston.**

Project: 62 miles of 26-in. extension from Bourbon to Rossville, Ill.

Status: Under way.

Contractor: **Contracting & Material Co.**, Evanston, Ill.

Union Hill Storage Co., 122 South Michigan Avenue, Chicago 3, Ill.

★ Project: 2 miles of 4-in. and 7½ miles of 12-in. in the Mahomet field pilot system in McLean, Piatt, and Champaign counties, Illinois.

Status: Pending FPC approval.

Completion: June 20, 1960.

United Gas Pipe Line Co., Box 1407, Shreveport 92, La.

★ Project: 59 miles of 36-in. purchase lateral connecting Bastian Bay field, Plaquemines Parish, Louisiana.

Status: Pending FPC approval.

Completion: Fall 1961.

Canadian Crude Oil Pipelines

Act Oils, Ltd.

Project: A 450-mile line from the Peace

PIPELINE CONSTRUCTION

River region of northern B. C. to tidewater at Kitimat, B. C.

Status: Proposed.

Bituminous Oil Pipeline Co. (Royalite Oil Co., and Can-Amera Oilsands Development, Ltd.)

Project: A 250-mile line from Athabasca oil sands in northeastern Alberta to Edmonton.

Status: Proposed.

Independent Pipe Line Co. (Home Oil Co.), Calgary.

Project: 1,073 miles of 36-in. from Edmonton, Alta., to Superior, Wis.; 946 miles of 34-in. from Superior to Montreal, Que.; 72 miles of 16-in. and 74 miles of 10-in. feeder lines from Calgary to Bellshill Lake, Alta., on the 36-in. line.

Status: Proposed.

Matador Pipe Line Corp., Denver, Colo.

Project: 175-mile line to carry crude from Burke, Bottineau, and Renville counties, North Dakota, to Cromer, Man., where it would tie in with the Interprovincial pipeline.

Status: Proposed. Representatives of Western Crude Marketers, Inc., Denver, have been conducting feasibility studies in North Dakota. Matador's application is pending before the Canadian Parliament.

Completion: Tentatively early summer 1960.

Mid-Continent Pipe Lines, Ltd., Edmonton, Alta.

Project: 1,500 miles of 30-in. from Edmonton to Chicago, via Saskatchewan, North Dakota, Minnesota, Wisconsin, and Illinois. U. S. section to be owned by International Oil Pipeline Corp., New York City.

Status: Pending Canadian Board of Transport Commission approval. W. C. Gilman & Co., New York City, has made preliminary study.

Peace River Oil Pipe Line Co., Ltd., Calgary, Alta.

Project: 233 miles of 8-in. to move crude from the Milligan Creek area of British Columbia to Trans Mountain Pipe Line in Alberta. The new line will connect with the Peace River system near Valleyview, Alta.

Status: To get under way early in 1960.

Completion: Possibly in the fall 1960.

Project: 8 miles of 6-in., 45 miles of 8-in., and 17 miles of 12-in. from its Fox Creek Pump Station to Windfall, Virginia Hills, and Swan Hills fields in Alberta.

Status: Approved.

Producers Pipelines, Ltd., 2236 Albert Street, Regina, Sask.

★ Project: 18 miles of 3 and 4-in.

Status: Under way.

Contractor: **Banister Construction Co., Ltd.**

Completion: May 30, 1960.

Rangeland Pipe Line Co., Calgary.

Project: 111-mile line from Cessford field to Calgary.

Status: Pending approval of Alberta government.

Trans-Prairie Pipelines, Ltd., Edmonton, Alta.

Project: 6-8-in. line from Weyburn field to Regina and Moose Jaw, Sask.

Status: Proposed.

Canadian Products Pipelines

Foothills Products Pipe Line Ltd. (Pembina Pipe Line Co., Mannix Co., Ltd.), Calgary, Alta.

Project: Gathering system to connect Alberta gasoline plants to tunk line from Alberta to Pacific Coast.

Status: Proposed.

Project: A line to carry sulfur, propane, and butane from the Calgary, Alta., area to Milwaukee.

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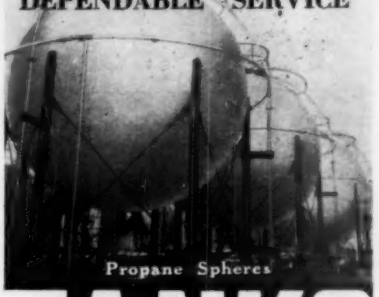

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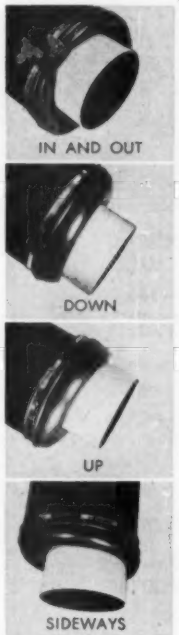

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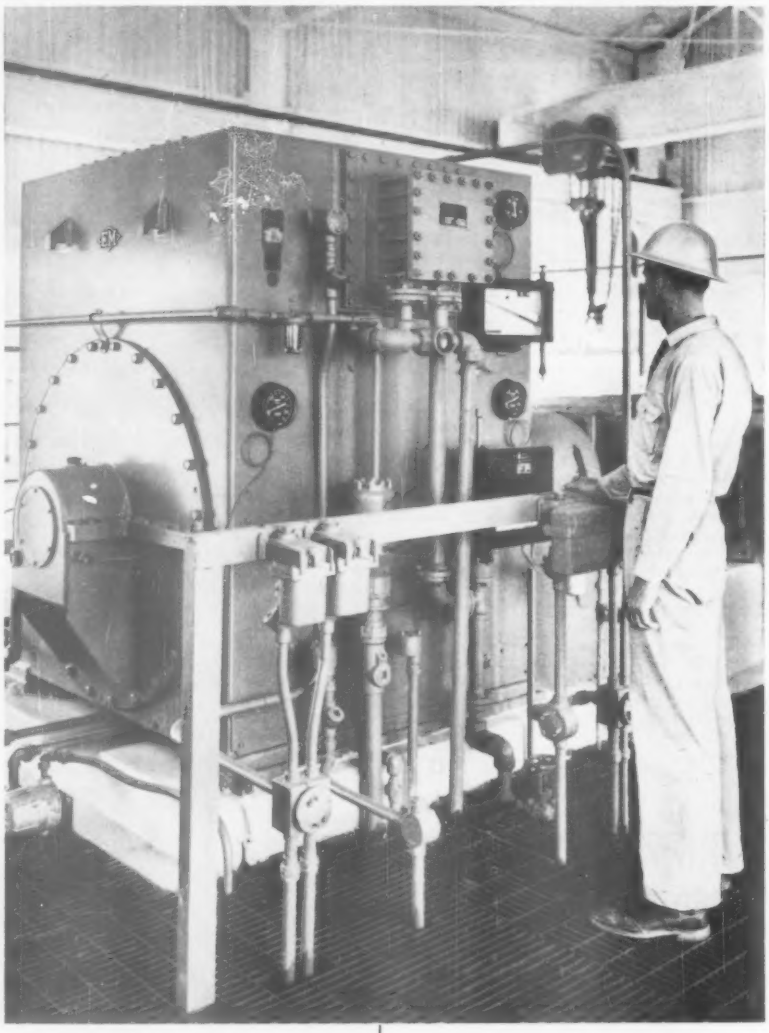
2. RUGGED DEPENDABILITY. E-M uses specially designed "box type" frames of heavy-duty plate steel reinforced with heavy bar-stock ribs. They cannot twist or distort. Air gap is accurate and permanent, as all frame welding is completed before precision boring. Ventilating gas passages are carefully engineered to provide unimpeded gas flow for optimum cooling.

3. ECONOMICAL OPERATION. In E-M TEIGF Motors, gas loss is lower than commercially accepted standards. Specially designed shaft seals are oil-pressure gas-sealed bearing type, virtually non-wearing. Where bolts enter outside casing, E-M engineers specify blind holes . . . tapping and drilling are done *into* casing, not through. Operating and maintenance costs are at a minimum.

Consult your nearest E-M sales engineer, or write the factory for TEIGF Motor Bulletin No. 226.



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1. Top-mounted gas-to-water cooler for use with suitable cooling water supply.
2. Forced-feed lubricated bearings and oil-pressure gas seals.
3. Oil pump, motor and oil filter. (Can be supplied optionally inside enclosure.)
4. Inert-gas temperature gauge.
5. Inert-gas pressure gauge.

(additional features shown in Bulletin No. 226)

TYPICAL OPTIONAL FEATURES INCLUDE:

1. Water cooler with double-tube construction for added protection against leakage.
2. Liquid level detector switch. Accumulation of moisture within motor sounds alarm or shuts down motor.
3. Bearing temperature relays, to sound alarm or shut down motor.
4. Explosion-proof motor terminal pothead or inert-gas filled terminal box.
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Status: Under study.

Hydrocarbons Pipeline Co., Winnipeg, Man.

Project: 800 miles of 6, 8-in. LPG line from near Edmonton to Fort William, Ont.

Status: Has Parliament of Canada approval. Seeking approval of Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board.

Contractor: **Dutton - Williams Brothers, Ltd., Calgary,** and **A. D. Little Co., Boston,** are consultants.

Pembina Pipe Line, Ltd., Edmonton, Alta.

Project: A 1,200-mile line to carry sulfur, LPG, and natural gasoline from Alberta's gas fields to eastern Canada.

Status: Proposed.

Canadian Natural Gas Pipelines

Alberta Gas Trunk Line Co., Ltd., Calgary.

Project: 256 miles of 36-in., 75 miles of 30-in., 55 miles of 26-in., 199 miles of various diameter gathering lines, and 42 miles of 16-in. delivery lateral. Main line is from Berland River, Alta., to Crows Nest Pass.

Status: Approved by Alberta government. Work to start at the beginning of the 1960 construction season. Line may be in operation by the end of 1961.

Project: 65 miles of 24-in., 10 miles of 12-in., 24 miles of 6-in., and 2 miles of 4-in.

Status: Planned.

Completion: 1960.

Alberta Natural Gas Co., Ltd. (Pacific Gas & Electric Co., San Francisco, and Westcoast Transmission, Calgary).

Project: 108 miles of 36-in. across southeastern British Columbia to U. S. border near Kingsgate, B. C.

Status: Pending approval of Canadian and U. S. regulatory agencies.

British American Oil Co., Ltd., 800 Bay Street, Toronto, Ont.

★ Project: 125 miles from Pincher Creek field in southern Alberta to the British American refinery at Calgary.

Status: Pending before Alberta Public Utilities Board.

British Columbia Electric Co., Vancouver.

Project: 35 miles of 30-in. from Huntington, B. C., to Vancouver.

Completion: 1960.

Canadian Western Natural Gas Co., Ltd., 140 6th Avenue, S. W., Calgary, Alta.

★ Project: 53 miles of 2 and 3-in. from Alberta Gas Trunk Line to various communities.

Contractor: Company personnel.

Completion: July 1960.

Cartier Gas Corp. (St. Maurice Gas, Inc. and Consumers' Gas Co., Toronto).

Project: 170 miles from Montreal to Quebec City.

Status: Proposed.

Magna Pipeline Co., Ltd., Nanaimo, Vancouver Island, B. C.

Project: 25 miles of 4.85-in. double flexible plastic pipe from Huntington, B. C., to Vancouver Island. It would go under the Straits of Georgia.

Status: Approved by British Columbia Public Utilities Commission. Tentative timetable calls for work to start by spring 1961.

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta.

★ Project: 110-mile trunk line, plus gathering system, from Lac La Biche, in McMurray vicinity, to Edmonton.

Status: Pending approval of provincial government.

Northern Natural Gas Co., Omaha.

Project: 73 miles of 20-in. from Savanna Creek to Pincher Creek, Alta.

Status: Planned.

Project: 32 miles of 24-in. from Pincher

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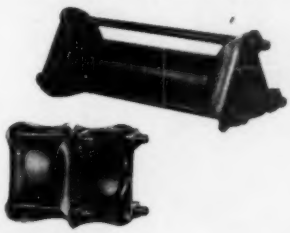

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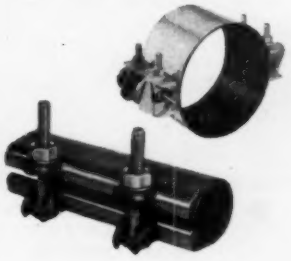

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PIPELINE CONSTRUCTION

Creek to Montana border to tie in with planned U. S. line on to Minneapolis.

Status: Planned.

Quebec Gas Transmission Lines, Inc., 1610 Sherbrooke St. W., Montreal.

Project: 300-mile line from Montreal to Quebec City.

Status: Proposed.

Trans-Canada Pipe Lines, Ltd., Toronto.

Project: 74 miles of 34-in. main-line loop (Burstall to Winnipeg, Man.) and 51-mile 30-in. lateral from Emerson, Man., to U. S. border near Noyes, Minn., to connect with proposed Midwestern system now before U. S. FPC.

Status: Pending government approval.

Completion: Fall 1960.

Project: An additional 390 miles of 34-in. main-line loop between Burstall and Winnipeg, Man.

Status: Planned. About 268 miles scheduled for construction in 1961, and 122 miles in 1962.

Van Tor Oil & Exploration Co., Vancouver, B. C.

Project: Line from British Columbia mainland to Vancouver Island.

Status: Proposed.

Westcoast Transmission Co., Ltd., Calgary.

Project: (See Alberta Natural Gas Co., Ltd., for joint project).

Project: 250 miles of 30-in. from Taylor to Fort Nelson, B. C.

Status: Planned.

Foreign Crude Oil Pipelines

Arab Pipeline.

Project: 1,250-mile pipeline from the Persian Gulf to Mediterranean serving fields in Saudi Arabia, Kuwait, Iran, Iraq, and Syria.

Status: Proposed by Saudi Arabian Government as project of Arab countries, and approved by the Arab League's petroleum department.

Arabian American Oil Co., Dhahran, Saudi Arabia, and 505 Park Avenue, New York.

★ Project: 63 miles of 30-in. from Khursaniyah pump station to Ras Tanura.

Status: Planned.

Contractor: Company personnel.

Completion: 1962.

★ Project: 1¼ miles of 24-in. from Khursaniyah separator plant to pump station.

Status: Under way.

Contractor: Company personnel.

Completion: Third quarter 1960.

Project: 18 miles of 34 and 36-in. from Qatif to Ras Tanura.

Status: Under way.

Contractor: Company personnel.

Completion: Third quarter 1960.

Project: 4 miles of 14-in. from Abqaiq separator plant No. 3 to QA-2 line.

Status: Planned.

Contractor: Company personnel.

Completion: Third quarter 1960.

Barnabos Group (Italian interests).

Project: A line from Venice, Italy, to Innsbruck, Austria, which could then be extended to Munich, Germany.

Basrah Petroleum Co.

Project: 65 miles of 30 and 32-in. from Zubair to Fao in southern Iraq.

Contractor: **Turriff-Burden, Ltd.,** Tulsa.

Completion: 1961.

Bolivia-Paraguay.

Project: 500 miles of 6-in. from Southeast Bolivia to a proposed refinery on Paraguay River, and later to Asuncion.

Status: Planned.

Cie. des Transports par Pipe-lines au Sahara (subsidiary of Cie. de Recherches et d'Exploitation de Petrole au Sahara), Paris.

Project: 420 miles of 24-in. from Edjele fields in Sahara to the Tunisian Mediterranean Coast.

Contractors: **Groupement des Societes Entrepose et Parisienne pour l'Industrie Electrique en vue de l'Etude et de la Construction de Pipe-Lines,** and **Ste. des Grands Travaux de Marseille.** Engineering firm on the job is **Bechtel Mediterraneenne S. A.** (subsidiary of **Bechtel Corp.,** San Francisco).

Completion: October 1960.

Creole Petroleum Corp., Caracas, Venezuela.

Project: About 8 miles of 12, 20, and 24-in. gathering line in Lake Maracaibo.

Status: Planned.

Completion: December 1960.

Eastern Block Council for Mutual Economic Aid.

Project: 2,500-mile "Vomecon" pipeline from the Volga-Ural oil fields in Russia to East Germany, Poland, Czechoslovakia, and Hungary. The system will originate at Kuybyshev on the Volga River and will split

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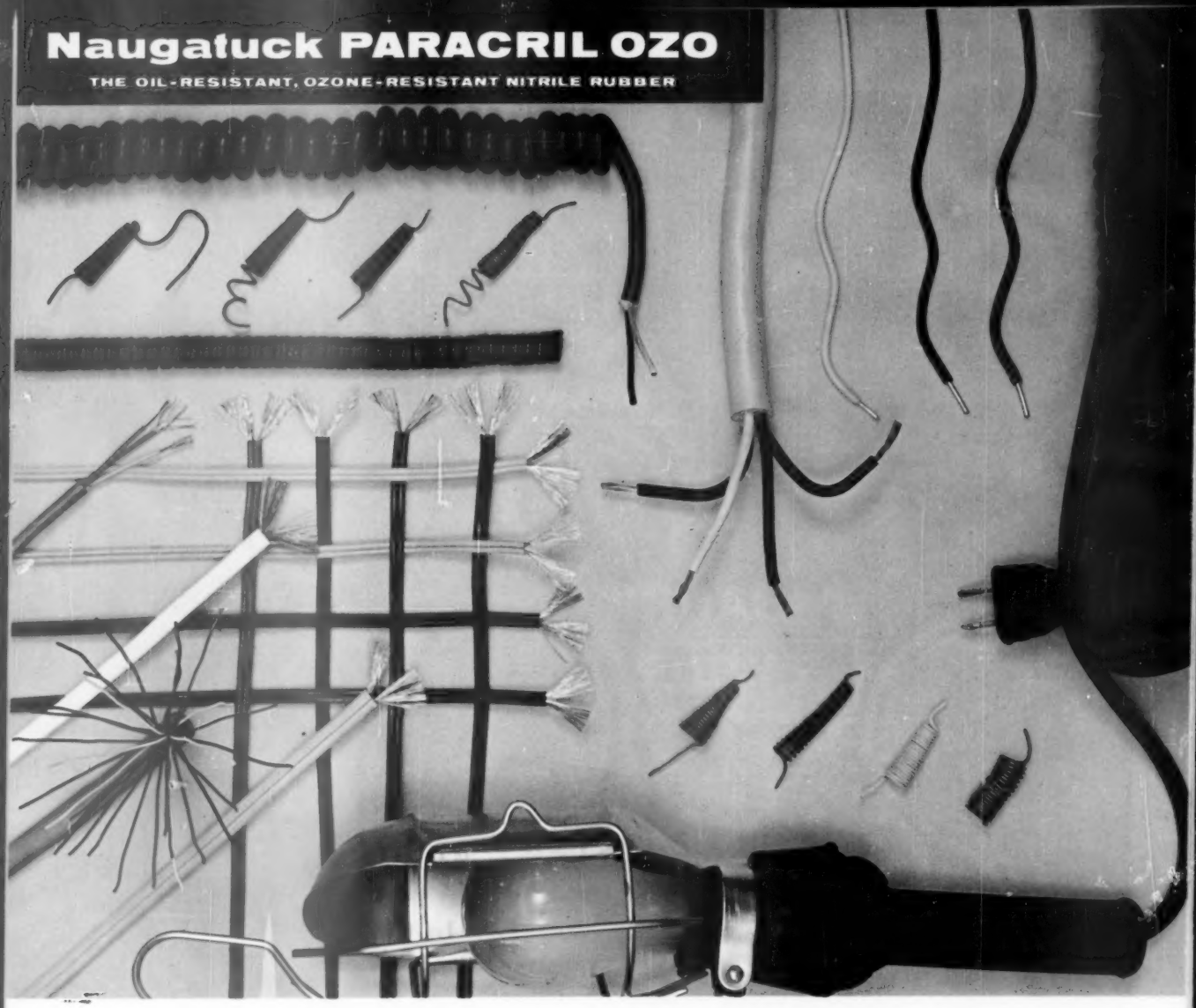

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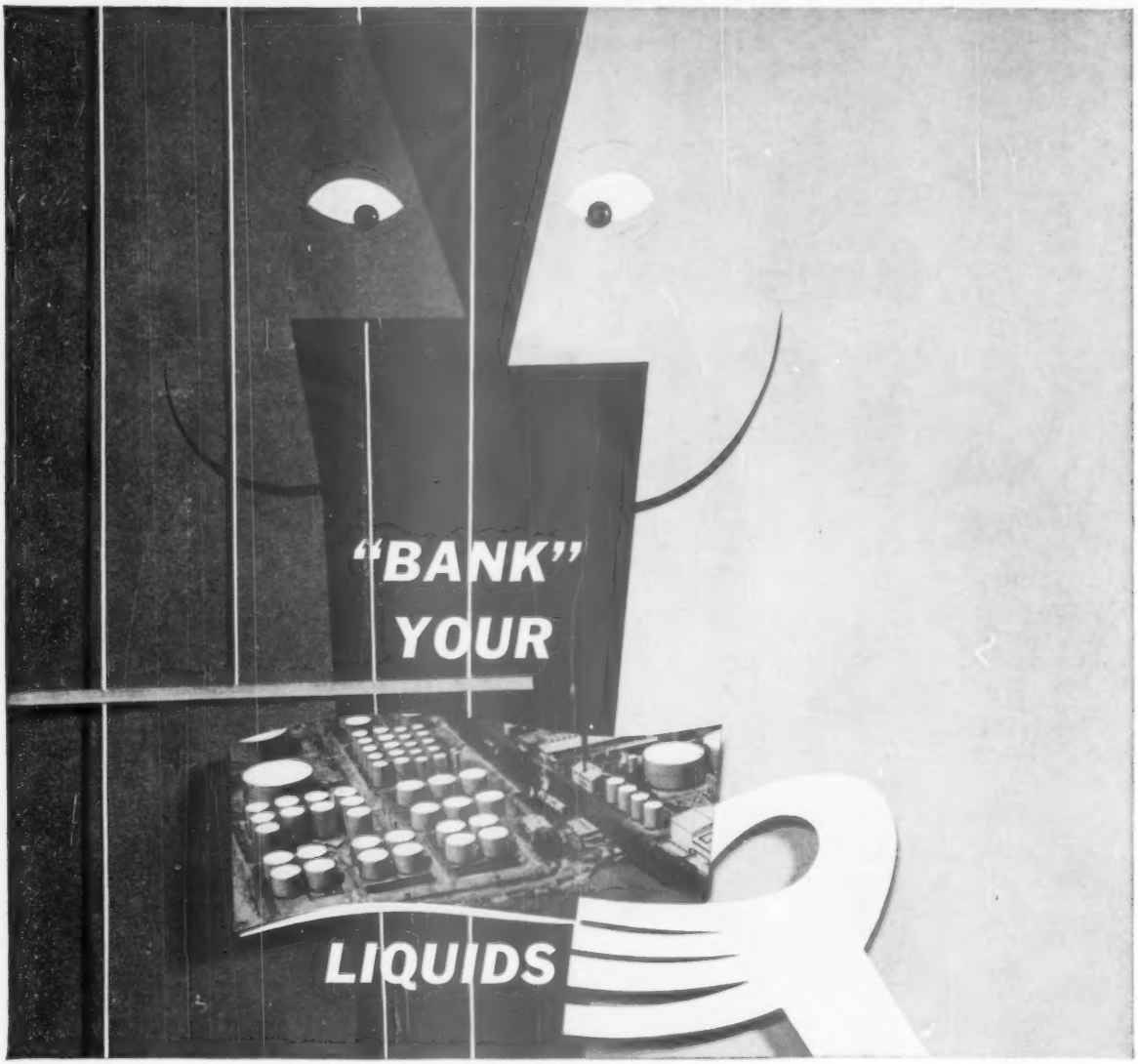

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- General American's warehouse receipts are accepted as the highest type of collateral.

For further information, call or write our nearest district office or terminal.

Terminals located at:
Carteret, N.J. (Port of New York), Chicago, Ill., Corpus Christi, Texas (Port of Corpus Christi), Pasadena, Texas (Port of Houston), Galena Park, Texas (Port of Houston), Good Hope, La. (Port of New Orleans).

GENERAL AMERICAN TANK STORAGE TERMINALS
GENERAL AMERICAN TRANSPORTATION *a division of* **CORPORATION**
135 South LaSalle Street, Chicago 3, Illinois

TANK STORAGE TERMINALS GENERAL AMERICAN TRADE MARK

into two branches at the Dneiper River, one going to Poland and Germany, the other to Czechoslovakia and Hungary. Expected capacity, 300,000 bbl. daily.

Status: Construction under way in Czechoslovakia, with completion of this section by early 1961.

Elburz Oil Corp.

Project: 1,000 miles of 38-in. to move Qum crude to the Mediterranean.

Status: Under way.

Empresa Nacional de Petroleo, Chilean Government company.

Project: 35-mile 8-in. outlet for fields in the Punta Delgada area of Magallanes Province.

Status: Under way.

Completion: March 1960.

ENI (Italian state oil agency) and **Italo-Swiss Finance Co.**

Project: A 700-mile system from Genoa to Aigle, Switzerland, thence northeast to the German border, where it would split with one branch going to Munich and another branch to the Karlsruhe area. Feeder lines would go to Turin, Milan, and Cremona, Italy.

Status: The trunk line from Genoa to Aigle has been approved by the Italian Government.

Esso Libya.

Project: 100 miles of 30-in. from Zelten field to the Mediterranean Coast.

Status: Pipe ordered. Route and terminal location not yet established.

Iranian Oil Participants, Ltd.

Project: 30 miles of 20-in. and 22 miles of 16-in. looping of Agha Jari to Bander Mashur line.

Status: Planned.

Project: 99 miles of 26, 28, and 30-in. from Gach Saran field to new terminal at Kharg Island in the Persian Gulf.

Contractor: A joint venture of **Raymond Concrete Pile Co.** and **Williams Bros. Co.,** Tulsa, **Richard Costain, Ltd.,** and **John Brown, Ltd.,** London and **Werkspoor & Bredoro,** The Netherlands.

Iraq Petroleum Co., Ltd., 214 Oxford Street, London, W. 1, England.

Project: 44 miles of 32-in. in Iraq., 21 miles of 24-in. in Syria towards Banias, and 38 miles of 30-in. in Syria and Lebanon toward Tripoli.

Status: Under way.

Israel Government.

Project: 16-in. loop of 8-in. line on 235-mile Gulf of Aqaba-Haifa system.

Status: Under way.

Completion: June 1960.

Project: Replace 125 miles of 8-in. from Elath to Beersheba with 16-in.

Status: Under way.

Completion: Mid-1960.

Kuwait Oil Co., Ltd., Burgan House, 105 Wigmore Street, London W. 1, England.

Project: 31 miles (balance) of 30-in. North Kuwait transit line.

Completion: March 1960.

Project: 20 miles of 6-in. Minagish transit line.

Status: Under way.

Completion: May 1960.

Oil India Private Ltd. (Burmah Oil Co. and Assam Oil Co., two-thirds, and India Government one-third).

Project: 720 miles of line in northeast India. This would include 260 miles of 16-in. from Nahorkatiya to Noonmati (site of proposed refinery), and 460 miles of 14-in. from Noonmati to Barauni (site of another proposed refinery).

Status: Contract award expected in February 1960.

Completion: 1962.

Petrofina, S. A., 31 Rue de Loi, Brussels, Belgium.

★ Project: 3-in. line from Galinda field to Bon Jesus, and 4-in. line from Bon Jesus field to a pipeline connecting Benfica field and Luanda, Angola, where Petrofina operates a refinery.

Status: Under way.

Completion: First half of 1960.

Petroleo Brasileiro S. A. (Brazil).

Project: 35 miles of 8 to 12-in. pipe from Buracica to Candeia.

Contractor: **Techint, Inc.,** Milan, Italy.

Project: 80 miles of 24-in. to tie in to proposed Caxias refinery near Rio de Janeiro.

Status: Planned.

Rotterdam-Rhine Pipeline Co. (N. V. Rotterdam-Rijn Pijpleiding Mij., owned 40% by Royal Dutch-Shell, 20% by Caltex, and 40% by Galsenberg & Mobil Oil Sales & Distribution Co.)

Project: 183 miles of 24-in. from Pernis, the port of Rotterdam, extending to Venlo, Holland, where it branches into one line to Wesel and a second to Godorf and Wesseling, Germany. The branch to Wesel connects with a 16-in. line to Gelsenkirchen.

Status: Under way.

Contractors: **Bechtel International Co.** is construction manager of the project which is being constructed by a group of Dutch and German contractors.

Completion: June 5, 1960.

Royal Dutch-Shell.

Project: 12-mile line from Gore Bay, Australia, to Royal Dutch-Shell's Clyde refinery.

Status: Planned.

Project: 161 miles 20-in. line from Tandzung field to Balikpapan refinery, Borneo.

Status: Planned.

Contractor: **Williams Brothers Overseas,**

(Continued on page 244)

HOLD THAT RIVER!

RIVER DIVERSION • BANK PROTECTION • PILE DRIVING

KENNETH W. HENSON

CONTRACTOR • ENGINEER

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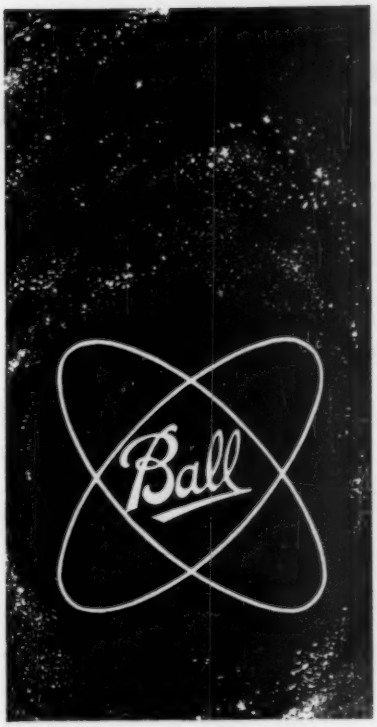
PAULS VALLEY, OKLAHOMA



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of instrumentation in the Petroleum Industry

Specializing in the fields of mechanical, electronic, optical, and electro-mechanical development.

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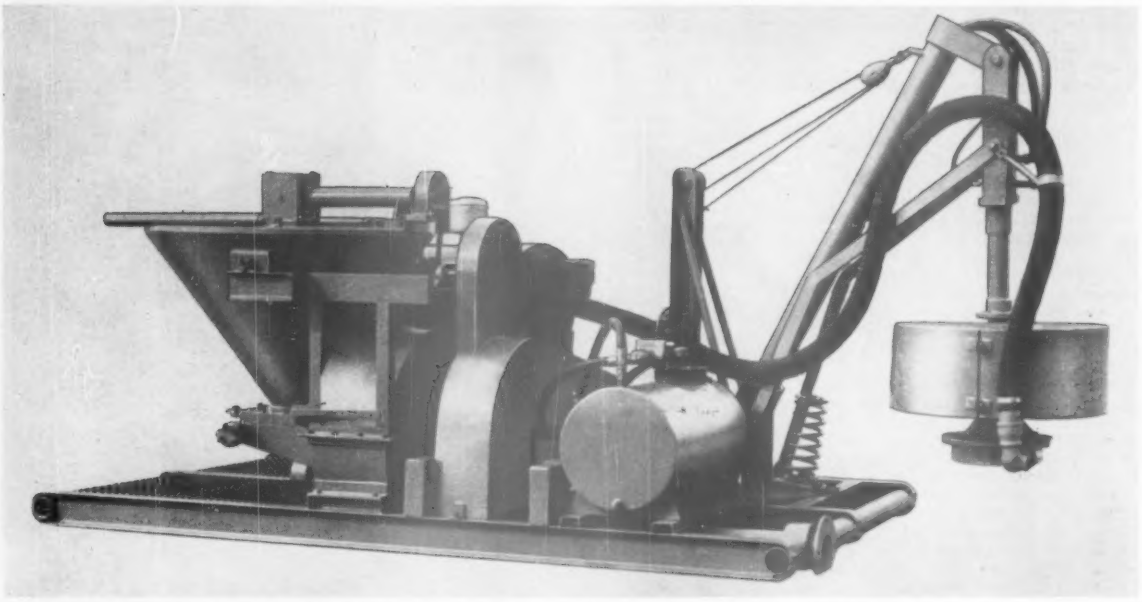
▶ ▶ ▶ New Equipment Section

This week's SHOWCASE features . . .



THIS NEW PUMP can hike gel yield to 15-30% more than mud mixed by usual methods of handfeed and jet mixing, the maker reports.

Mud, chemicals mixed easily with new pump

ON A NEW mud pump recently developed, the automatic feed and mixer is designed to give close control of dry muds and chemicals (except caustic soda) mixed in the mud system. According to the maker, the pump can save mud as it delivers mud to the system thoroughly mixed. The maker also reports field tests show it can provide an increase in gel yield of 15 to 30% over mud mixed by the usual method of handfeed and jet mixing.

If desired, a system of mud may be mixed and on hand ready for drilling out from under the surface. This may be accomplished by setting up a mud system and mixing mud while completing rigup of remaining equipment.

The Thompson mud and chemical mixer is a complete unit and needs no additional pump or power. It offers a way to save labor, since when the hopper is filled and the correct feed set, the crewman is free for other work until the hopper is empty. No high-pressure jets are used in the mixer, thus there is no cutting action due to high-pressure abrasive mud.

Specifications of the unit include: (1) length, 11 ft. 6 in.; (2) width 6 ft. 4 in.; (3) height, 6 ft. 7 in.; (4) horsepower required, 36 b.hp. at 1,500 r.p.m.; (5) hopper volume, 500 lb. bentonite, 1,000 lb. barites; (6) hopper feed rate, 100 to 3,500 lb. per hour; and (7) pumped volume, 250 g.p.m. Source: **Thompson Tool Co., Iowa Park, Tex.**

Want more facts about equipment or copies of product literature described in this issue?

Send this **Showcase Coupon**

to manufacturer at address shown in bold type after each item.

Product name, Model no., literature title or number: .....

Described in OIL AND GAS JOURNAL - Issue of **March 28, 1960**

NAME ..... TITLE .....

COMPANY .....

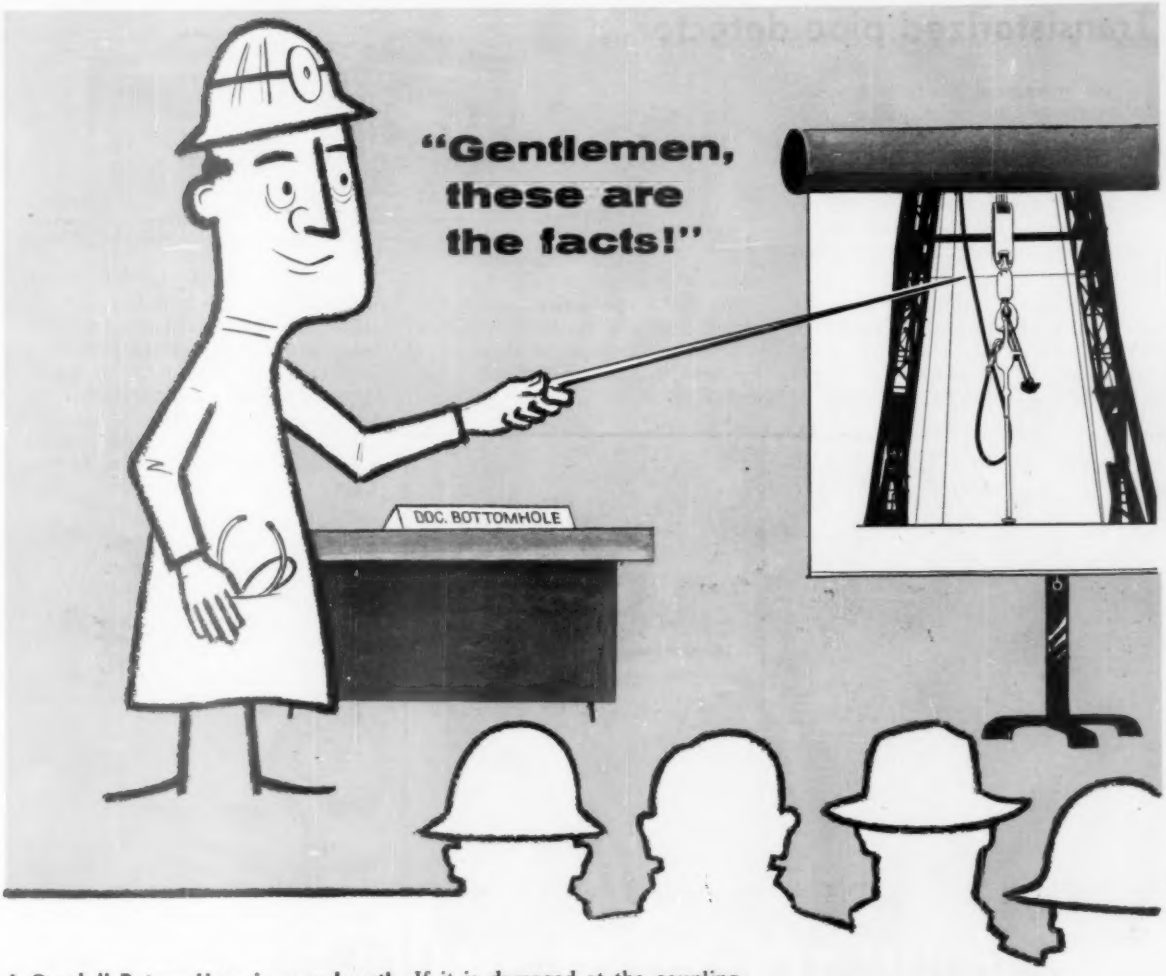
ADDRESS .....

CITY ..... STATE .....

New coating

. . . dries fast according to the maker. The Speedy-Dry coating is specially formulated to air-dry to touch in less than 30 minutes, according to the maker, and it provides a durable film for use in production and maintenance uses on metal or wood.

It can be put on by spray, brush, or dipping. It dries to a high-gloss finish. Numerous colors are available. Source: **Rust-Oleum Corp., 2799 Oakton, Evanston, Ill.**



A Goodall Rotary Hose is over length. If it is damaged at the coupling, you don't have to replace it. Goodall will repair it good as new for $125—and you still have a standard API length hose. If the hose is crushed in the middle, Goodall will make a two-piece rotary hose from the damaged sections for $350. From a salvable Goodall Rotary Hose, you can get one or more API vibrating hose for as little as $125 each. When you have received all possible use from your Goodall Hose, you get $50 credit by simply returning the used set of Barney Couplings.

When selecting your next rotary hose remember: Goodall's Long-Life Rotary Hose is the best hose made for the high pressures and abuse that today's rotary hose must take . . . and no other hose offers such outstanding economy.

These exclusive features are available *only* with Goodall Long-Life Rotary Hose:

The Barney Coupling

The Goodall Safety Clamp

The Goodall Repair Service

The Goodall One-Year Guarantee

GOODALL RUBBER COMPANY

TRENTON, N. J.

Goodall Rubber Company of Texas: Houston, Odessa and Wichita Falls.

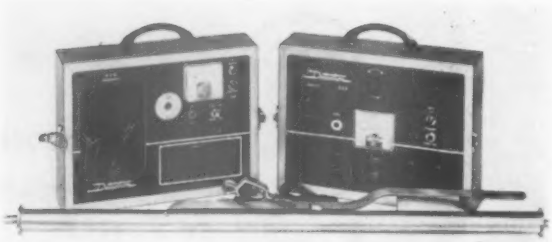
Goodall Rubber Company: New York, Philadelphia, Pittsburgh, Chicago, Denver, St. Paul, Detroit, San Francisco, Los Angeles, Seattle, Salt Lake City, Portland, Boston, Indianapolis, Kansas City, Milwaukee, Stuart, Miami, Charlotte, Atlanta, Toronto. (Petroleum Rubber Ltd., Calgary, Edmonton.)

Export: Goodall Rubber Company, Trenton, New Jersey.

Stocking Distributors: Texas and Louisiana—Houston Oil Field Material Co., Wilson Supply Company, Hunt Tool Company, Superior Iron Works & Supply Co., Inc.; Oklahoma and West Texas—Iverson Supply Company; Stocking Representatives: Heap Equipment Company, Odessa.

Available through all qualified supply stores.

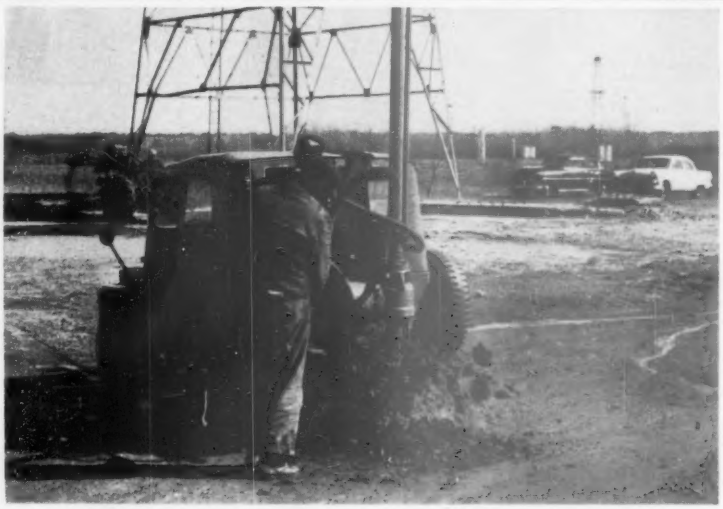
Transistorized pipe detector



. . . just announced has been designed to overcome the inadequacies normally inherent in transistors, such as heat limitations, by the use of special compensating circuitry. Thus, according to the maker, the Model 808 detector is suited for use in hot climates where heat stability of transistors has been a problem.

Two transistors, instead of one, are used in the transmitter so maximum power is available. According to the maker, one of the biggest advantages of the new detectory over tube type of instruments is in tracing pipes and cables by the conductive method. Cut-off of the new model is unusually sharp, assuring separate detection of pipelines lying close together, the maker claims.

Other uses of the detector include location of valve boxes, services, studs, and other metal objects. Maximum depth range of the instrument on large lines is from 20 to 25 ft., depending upon soil conditions. Delivery: 3 weeks. Approximate list price, f.o.b. factory: $200. Source: **Computer Measurements Co., Sylmar, Calif.**



60 OIL WELLS PROTECTED FROM CASING CORROSION

A major company operates 60 oil wells in a field in Coke County, West Texas. When external casing corrosion became a problem, it was decided to protect 35 of the wells cathodically. CSI was given engineering and turn-key installation contracts on a competitive bid basis.

CSI determined the current required for protection on each well, using the "log current potential method" developed and *patented* by a CSI engineer. Current requirements were verified by a down-the-hole potential drop profile. Then CSI installed rectifiers to supply the current.

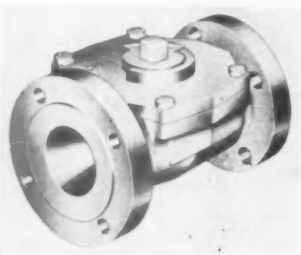
Recently CSI was recalled—again on a competitive basis—to protect the other 25 wells. CSI again installed rectifiers. CSI also submitted a report covering all installation data, and instructed company personnel on the operating of the rectifiers.

You can benefit from the expert engineering and installation services offered by CSI engineers—who helped pioneer cathodic protection for pipe lines, well casing, tank bottoms, etc. CSI also offers quality supplies for both rectifier and magnesium anode installations. Call or write today.

CSI

Cleveland 13, Ohio
1309 Washington Ave.
Tel. CHerry 1-7795

CORROSION SERVICES INCORPORATED
General Office, Tulsa, Okla.
Mailing Address:
Box 787, Sand Springs, Okla.
Tel. Circle 5-1351

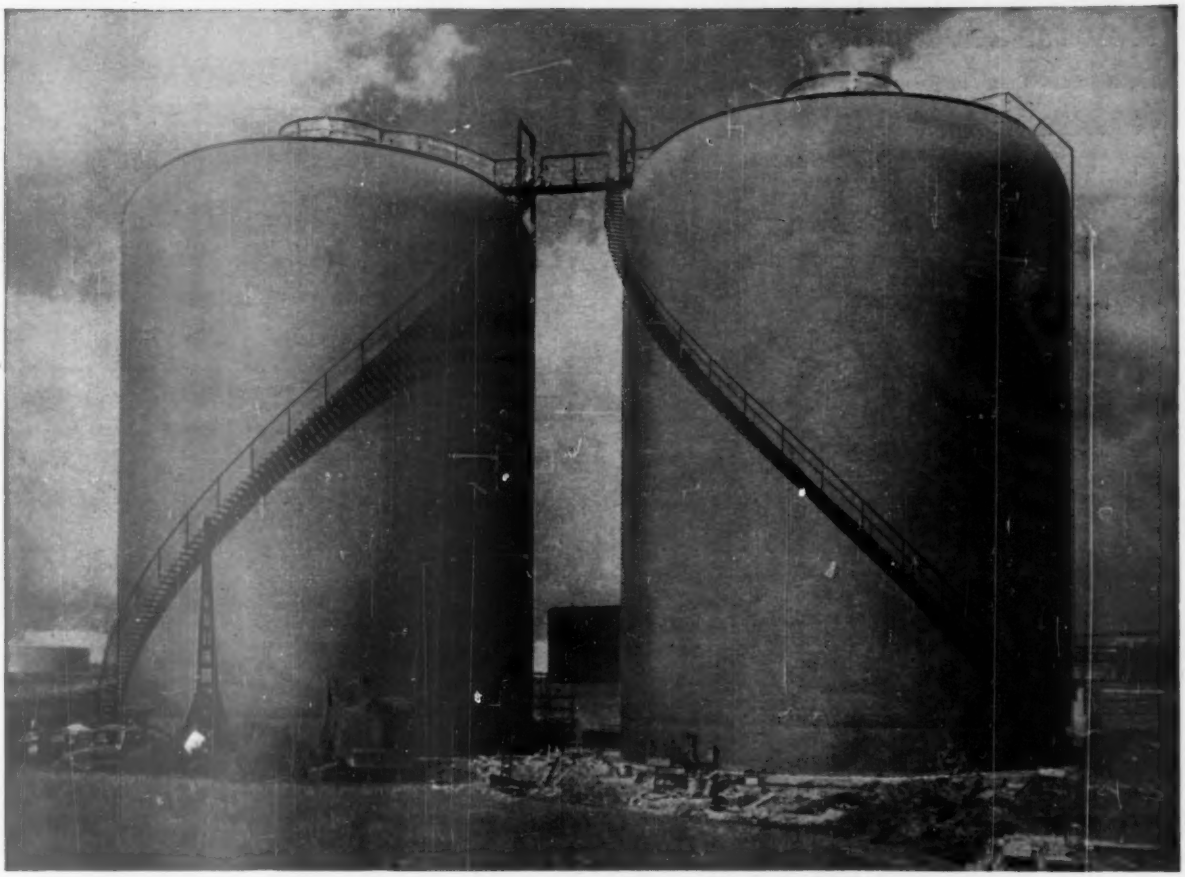


Valve serviced

. . . without removal from the line. The new 711 series Flo-Ball valve comes in sizes from 1 to 10 in. They are engineered around a fixed-bearing principle. The ball rotates on a fixed axis between bearings that need no lubrication. According to the maker, the ball can absorb strong impacts and loading without backlash or danger of distortion.

To service the valve, just remove four bolts from the top flange and lift the flange off. This gives access to the three removable parts, two seats and the ball. Readily replaceable, the seats are balanced, self-aligning, and self-adjusting for controlled seat loading and positive sealing, according to the maker. Operating temperatures range from −20° to 400° F.

Operating pressures range from vacuum to 300 psi. Available materials include semisteel, Type 316 stainless steel, carbon steel, and aluminum. The flanges are ASA 125 and 150 lb. Delivery: from immediate to 30 days. Approximate price, f.o.b. factory: for ASA 125 lb. semisteel reduced port, from $32.70 for a 1-in. to $630 for an 8-in. valve. For ASA 150 lb. carbon-steel reduced port, from $42.30 for a 1-in. to $650 for an 8-in. valve. Source: **Hydromatics, Inc., 70 Okner Parkway, Livingston, N. J.**



Two Beauties for Butadiene

"Cool" is the word for these ellipsoids . . . they're built to store butadiene at just-above freezing temperatures, which in Texas means about 45° below ambient temperature. They're 60 feet in diameter and 62 feet high, with storage capacity of 40,000 barrels each.

Butadiene is a problem child when it comes to storage. Vessels must be cold-storage as well as safety-vaults. Operating in an ambient temperature of 80° F the butadiene liquid in these twin ellipsoids had to be refrigerated to 35°F at 10 psig so that it could be kept "indefinitely."

At higher temperatures butadiene will deteriorate. Four inches of glass fiber insulation help maintain the low storage temperature to guarantee the quality of the butadiene.

It takes a heap of know-how and experience to build tanks that meet such stringent requirements. We are proud to have been given the opportunity to build these two ellipsoids for Hess Terminal at Galena Park, Texas.

For any type of process vessel made of metal plate, consult the Pittsburgh-Des Moines Steel Company.

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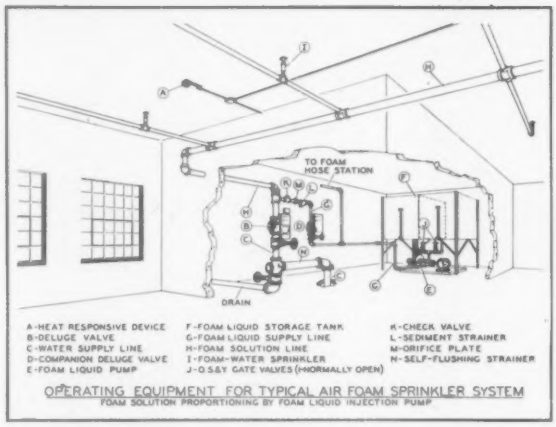
licensees and sales offices in many foreign countries including Argentina, Australia, Belgium, Brazil, Canada, Chile, Colombia, England, France, Haiti, India, Italy, Japan, Mexico, Netherlands, Peru, Puerto Rico, Sweden and W. Germany.

Newest advance in fire-fighting

. . . systems is an air-foam sprinkler type based on the theory of "equivalent isolation." The term "equivalent isolation" is defined as the ability, through means of special fire-protection methods, to establish, in effect, isolation of equipment and processes from spilled flammable-liquid fire hazards which, by the nature of the equipment and processes, cannot otherwise be removed before they are damaged.

The system is a mechanical foam-water system. Within 1 minute, a blanket is laid between the flammable liquid and the objects to be protected. The air foam blanket is usually applied at a rate of over 2 in.-deep per minute for a period of 10 minutes. Advantages cited for the system include: (1) reduced space requirements, (2) improved drainage conditions, (3) prevention of fires from spilled flammable liquids, and (4) reduced water requirements for fire protection.

Principal components of the system number about 10. They include heat-actuated devices to detect the rate of heat rise, deluge valves to operate automatically from the heat-actuated devices, foam-liquid injection pump, foam-liquid storage tank, and a foam-water sprinkler.



OPERATING EQUIPMENT FOR TYPICAL AIR FOAM SPRINKLER SYSTEM
FOAM SOLUTION PROPORTIONING BY FOAM LIQUID INJECTION PUMP

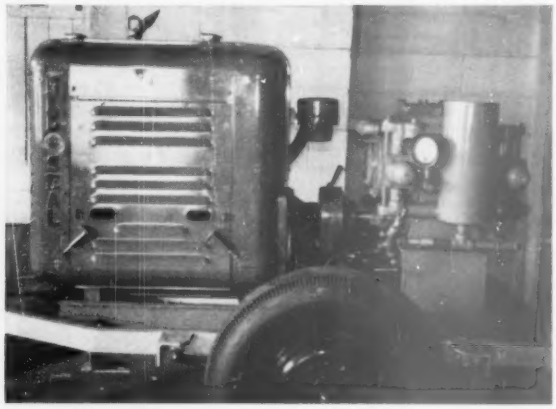
An abnormal rate of temperature rise expands air in the heat-actuated devices and trips the deluge valve. This starts the foam-liquid pump and opens another deluge valve. Foam liquid is introduced into the water supply. The foam solution is discharged from the foam sprinkler, coating the ceiling, falling on process equipment, and blanketing the floor. Operation continues for about 10 minutes. Approximate price of the system ranges from $2,000 for a small room up to $200,000 for a group of aircraft hangars. Source: **Automatic Sprinkler Corp. of America, Jones & Brittain Streets, Youngstown 1, Ohio.**

●

Soil removed faster

. . . with a new solvent additive, called Acalaid, that is added in the range of 5 to 10% by volume to the maker's acidic or alkaline solutions to increase their cleaning ability. According to the maker, it is economical as it is used only where needed to increase the maker's standard solutions. It may eliminate the need for more concentrated and more expensive cleaners.

(Continued on page 234)



HYDRO-Air PRESSURE CLEANER

With this Hydro-Air pressure cleaning unit, gun, and nozzles, you can . . .

Clean tubes or heavy equipment faster and cheaper

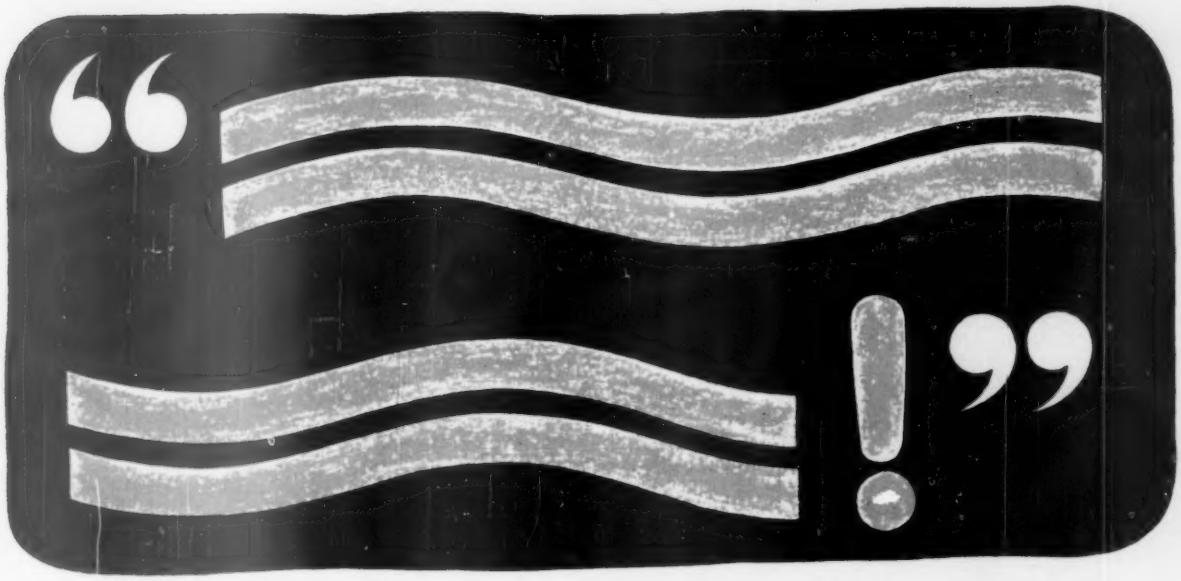
The high-pressure cleaning unit delivers water and air through the Hydro-Air gun at rates of 25 to 50 g.p.m. and at pressures from 500 to 6,000 psi. to knock scale, dirt, or grease from your equipment fast. You'll find it can cut cleaning costs as much as 90% over other cleaning methods.

For more severe cleaning jobs, you can convert the unit into a sand-blaster. Just attach your sand hose to the air gun.

With the Hydro-Air jet-propelled revolving nozzles, you can clean the inside of tube bundles fast and easily. By use of a flexible hose, these nozzles will pull themselves as much as 150 ft. into pipes with a 45° turn.

To solve your cleaning problems, just contact:

Hydro-Silica Mfgs.
Route 2 Buchanan, Michigan
Tel: New Troy Hazel 62144



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the answer to greater understanding and effectiveness in engineering

Productive communications — the quick, accurate and understandable transmittal of ideas, conclusions and decisions — from drawing board to fabrication — play a vital role in the design and manufacture of Western Heat Exchangers . . . and are greatly responsible for the reputation Western enjoys for personal attention to the detail of each customer's needs.
Western's design, rating and service efficiency, as well as its quality of workmanship, depend upon maintaining "fluid, fluent" communications with our customers and our own personnel. We would be pleased to establish this "line of communication" with your engineering department, when you next require heat transfer equipment.

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. . . is in your young engineers — the engineering executives of tomorrow. In 1960, therefore, Western presents a series of messages on subjects of importance to the personal and professional advancement of all engineers. These messages, as shown at right, appear monthly in major trade journals, with a more complete treatment of each subject available in pamphlet form, singly or in quantities, upon request.

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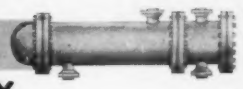
HEAT EXCHANGERS



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Communicating your convictions gains better understanding, improved relations, greater results for engineers

Breathes there a man with soul so dead, who never to his friend has said, "Don't those lamebrains in the . . . Department ever get ANYTHING right? . . . I very carefully wrote EVERYTHING down, very logically and clearly . . . didn't leave a thing out . . . and they still don't get my point!" — or words to that effect?

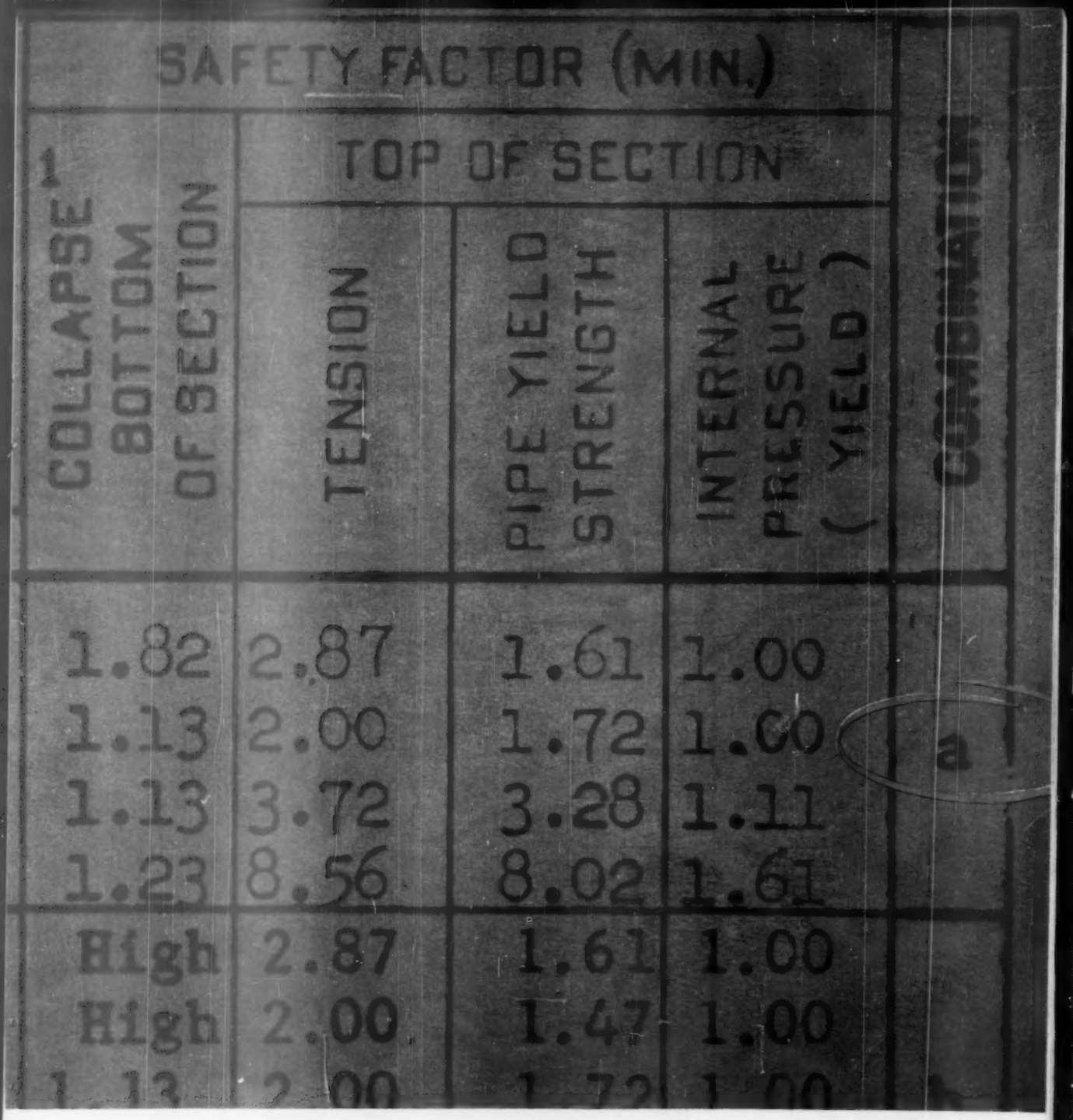
The only qualification you need for having voiced these sentiments is that you occupy yourself daily with one or

The wizard of oil

This National Tube field engineer is a modern-day Merlin, because he designs more economical and more efficient casing combinations.

He does it without magic or sleight-of-hand, but with years of field experience and technical knowledge. He figures several casing combinations with razor-sharp accuracy, lists them on a form, and submits it to a customer. The customer then picks the combination that best fits his program—in this case it was combination "a."

Our field expert carefully explores the customer's operating methods. Does he run his string fast or slow? Type of equipment? Drilling technique? Location? If it's an offshore



SAFETY FACTOR (MIN.)				
	TOP OF SECTION			
COLLAPSE[1] BOTTOM OF SECTION	TENSION	PIPE YIELD STRENGTH	INTERNAL PRESSURE (YIELD)	COMBINATION
1.82	2.87	1.61	1.00	
1.13	2.00	1.72	1.00	a
1.13	3.72	3.28	1.11	
1.23	8.56	8.02	1.61	
High	2.87	1.61	1.00	
High	2.00	1.47	1.00	
1.13	2.00	1.72	1.00	

project, he'll include an extra safety factor. This engineer's strict attention to detail results in a casing combination that promises efficient, economical and satisfactory service.

A great many customers have benefited from our experience. You can too. National Tube is the world's largest and most experienced manufacturer of tubular products. Write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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Until now there has been no single source of accurate and unbiased information on this enormously rich area of investment. That is why investors should not fail to see a free examination copy of this extraordinary new guide.

How To Get Tax-Protected Income From Oil and Gas Investments

Revised & Enlarged 2nd Edition

Now you need not be an "insider" to participate in the tremendous income, capital building and tax benefits inherent in oil and gas. This manual shows you:

(1) **How to get into oil and gas investments; how investment opportunities develop and how to share in them; acquiring interests; joint operations; development, operation, and payments to investors, etc.**

(2) **How taxes reduce the risk; tax plans which produce maximum net-after-tax returns; family tax plans; organizing oil and gas ventures; assuring your retirement through oil.**

(3) **Actual case-histories of oil and gas investments and the potential payoffs (with these to guide you, you can readily decide the best money-making strategy.)**

Why miss out on the benefits of this tremendous field? Send today for a free examination copy. Keep it for two weeks, then return it without obligation, or keep it and send only $12.50 plus shipping charges in full payment. (Save shipping charges by remitting $12.50 now—same refund privilege.) Write today to Dept. OG-13, Business Reports, Inc., Larchmont, New York.

SHOWCASE . . .

New Equipment

The additive may be used in tanks at temperatures from 140° to 160° F. and in closed systems at temperatures between 180° and 200° F. It is neutral in pH, assuming the pH of the solution to which it is added. Source: **Oakite Products, Inc., 159 Rector, New York 6.**

●

Equipment cleaning

. . . in a hurry is promised by this high-pressure Hydro-Air cleaning unit. It delivers water and air through the cleaning gun at rates from 25 to 50 g.p.m. and at pressures from 500-6,000 psi. to remove scale, dirt, or grease from tube bundles, drilling rigs, pumping units, and other heavy equipment. The maker claims that it can reduce cleaning costs as much as 90% compared to other cleaning methods.

For severe cleaning jobs, the unit can be converted into sand-blast equipment by attaching a sand hose to the cleaning gun. A variety of sizes of jet-propelled revolving nozzles are available for use with the unit. These permit the cleaning of the inside of tube bundles. According to the manufacturer, by use of a flexible hose, the nozzles will pull themselves as much as 150 ft. into pipes with a 45° turn. Source: **Hydro-Silica Manufacturers, Route 2, Buchanan, Mich.**

●

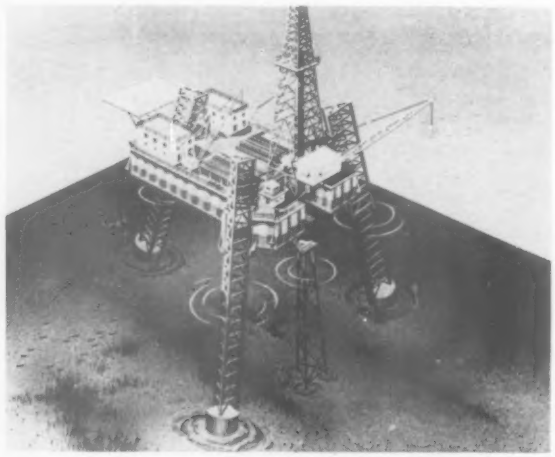
Microwave carrier

. . . with 600 channels, a transistorized multiplex type for cable as well as microwave has been disclosed. The system is capable of handling up to 600 voice-frequency channels on a single radio beam, according to the manufacturer.

The single-sideband suppressed carrier system is said to have toll quality capable of meeting international and domestic long-distance standards.

For high reliability, a standby component is used for each component in the common equipment.

Upon failure of an individual part, the parallel component keeps operating with no switching delay to seriously affect data transmission. The equipment comes in a compact modular design and is one-third the size of conventional tubed equipment. Source: **General Electric Co., Lynchburg, Va.**



Dual-depth offshore platform

. . . has been disclosed for drilling in 125 to 150-ft. deep water. It is a wide-base slant-leg type. An advantage cited for the platform over conventional types is that it can be readily modified for greater depths later. As an example, the maker reports that a slant-legged tripod platform for 150 ft. of water can be increased to 200-ft. depths for only about 6% additional cost. The first slant-legged platform is expected to be built this year. Source: **R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Tex.**

Leader for 22 years

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For more than two decades UOP No. 5 Inhibitor has been leader of the most widely-used class of inhibitors—butyl phenylene diamine—the standard by which all other antioxidants are judged.

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SHOWCASE . . .

New Literature

Impervious-graphite

. . . equipment cost-data booklet recently revised contains: (1) a typical drawing or illustration of each type of equipment; (2) available models; and (3) approximate cost per square foot of heat-transfer area for exchangers or other appropriate cost unit for other types of equipment. Added to the 32-page brochure are Paralel and Modular exchangers, valves, crucibles, thermowells, and both armored and non-armored types of pipe and fittings.

Detailed cost data is provided for cross-bore exchangers, immersion heaters, cascade coolers, and rupture disks. Comparative costs and assembly techniques are shown for two systems of impervious-graphite pipe and fittings. Source: **Falls Industries, Inc., Aurora Road, Solon, Ohio.**

Composite curve

. . . in three colors shows relative head-capacity performance of Chempump sealless pumps. Available upon request, the curve can be used as a guide to specific model performance curves. Curves are based on 60-cycle operation. Source: **Chempump Div., Fostoria Corp., P. O. Box 35-10, Huntingdon Valley, Pa.**

Proximity switch

. . . which senses ferromagnetic material without physical contact is outlined in Data Sheet 163, obtainable upon request. The 4-page technical publication gives photos, dimension drawings, and descriptive diagrams of sensitivity range, sensitivity envelopes, mounting requirements, and wiring instructions. Information on operating and electrical characteristics and prices is also included. Source: **Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.**

Bulk handling

. . . and storage of (1) sulfuric acid and oleum (Bulletin I-182); (2) chlorosulfonic acid (Bulletin I-181); and (3) muriatic acid (Bulletin I-183) are outlined in three new publications. The illustrated bulletins are designed to give technical assistance in setting up safe procedures in the bulk unloading, handling, and storage of materials.

Each publication covers shipments,

Imperative Reading

Oil and State in the Middle East

By GEORGE LENCZOWSKI
University of California, Berkeley

How can the Western oil corporations best meet the challenges they face in the ever-changing Middle East? In this dispassionate search for constructive answers, an astute political analyst links the operations of the oil industry to the broad socioeconomic and political background of the areas in which it operates.

Realistically and impartially he discusses such topics as the legal and political aspects of oil concessions, controversial boundary problems, the development of unified Arab oil policies, and the repercussions of the Suez crisis. The whole sector of human and industrial relations is covered in his analysis of the industry's contacts with the governments, the public, and the employees of the host countries.

Neither an apologia for the oil industry nor a crusading document favoring Middle East nationalists, Lenczowski's book is certain to spark fruitful discussion and argument. *398 pages,* $6.75

Also by George Lenczowski—

The Middle East in World Affairs

SECOND EDITION *596 pages, maps,* $7.25

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124 Roberts Place, Ithaca, New York

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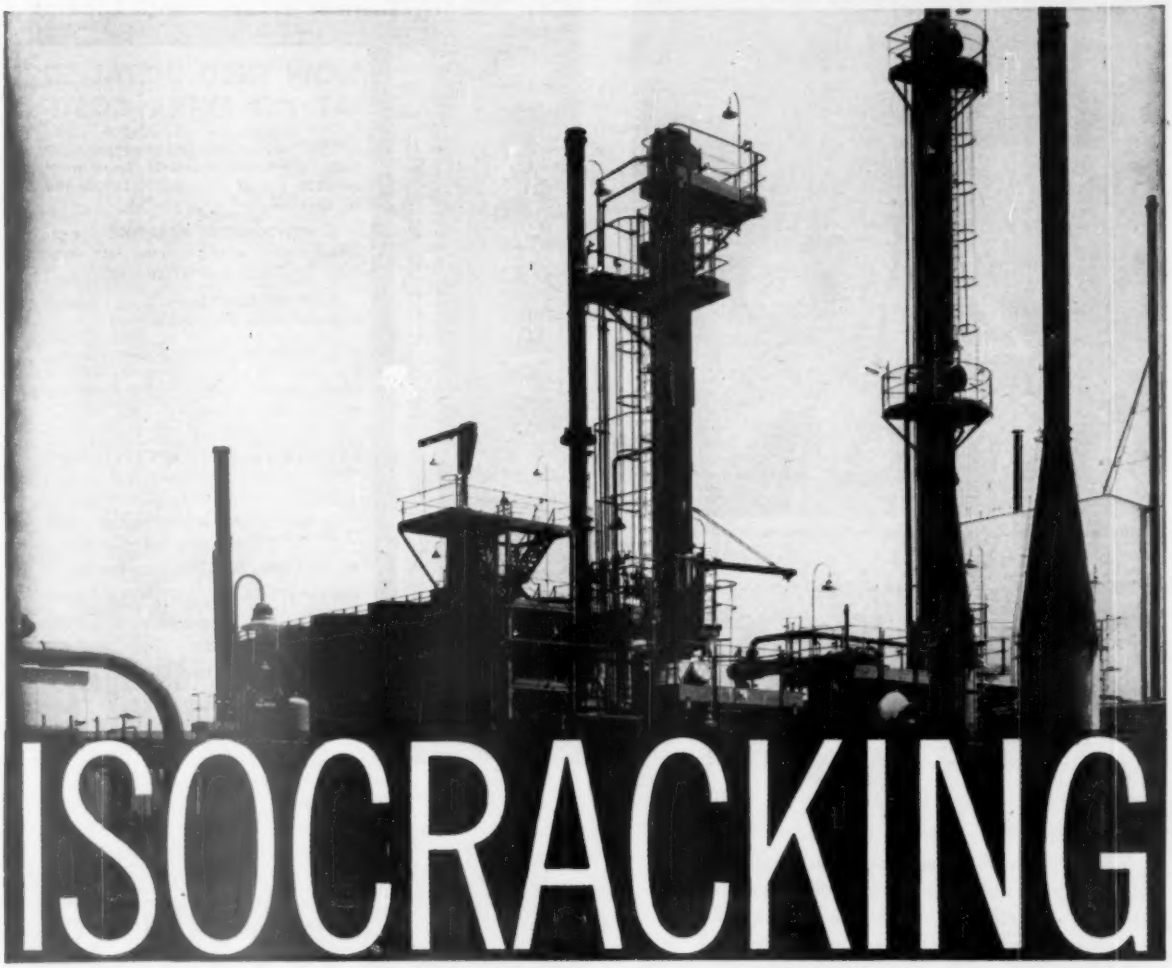

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Developed by California Research Corporation, the *Isocracking* Process is proving out benefits in refinery economics long predicted for hydrocracking. Under moderate processing conditions, *Isocracking* gives better than 100 per cent yield of over-103-octane gasoline blending stock from refractory light distillates.

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The *Isocracking* Process is offered under license by California Research Corporation, and pilot plant facilities are available for evaluation of feed stocks.

For complete details, write for brochure:
California Research Corporation, 200 Bush St., San Francisco 20, Calif.

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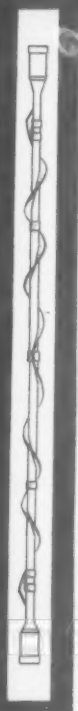

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tank - car - dome fittings, tank - truck pipe fittings, factors to consider in determining storage-tank sizes, construction materials, level indication, tank car and tank-truck unloading methods, product sampling, and safety factors. Source: **Inorganic Chemicals Div., Monsanto Chemical Co., 800 North Lindbergh Boulevard, St. Louis 66.**

Use of sealless "canned" pumps

. . . for leakproof pumping of ethylene and propylene chemicals is discussed in Technical Bulletin 2 now available. It deals with: (1) value of high reactivity of the chemicals; (2) pump advantages in stopping leakage and contamination while cooling; and (3) maintenance problems lessened with leakproof pumps. Source: **Chempump Div., Fostoria Corp., P. O. Box 35-21, Huntingdon Valley, Pa.**

Compressors

. . . that have been redesigned and designated Type HRA-T (gas-engine driven and turbocharged) are detailed in recently published Bulletin 179. It describes and illustrates the crankcase, bed section, pistons, crossheads, and running gear, all of which have been made heavier and more massive to handle additional horsepower developed from turbocharging. The 6-page publication contains complete specifications and dimensions. Source: **Clark Bros. Co., Olean, N. Y.**

Leak testing

. . . of tanks, piping, and other enclosures are detailed in 6-page Bulletin GET-2936, which gives instructions on the use of halogen leak detectors for finding leaks in enclosures that can be pressurized. Applications discussed include hydraulic systems, steam boilers, valves, piping, and transformers. The literature offers a discussion of system preparation, testing procedures, quantitative measurement techniques, and calibration. Source: **General Electric Co., Schenectady 5, N. Y.**

Hydrocarbon detector

. . . which is a completely self-contained portable instrument for fast measurement of total organically bonded carbons in atmosphere or gases, is outlined in a newly published bulletin. It reports that the Model 213 detector simply and accurately detects and measures fractions of parts per million of such organic carbon compounds as hydrocarbons, aldehydes, detones, alcohols, and amines with a sensitivity range adjustable from 0-1 p.p.m. to 10% full scale. The brochure describes operation, use, and specifications of the instrument in 8 pages. Source: **Perkin - Elmer Corp., Norwalk, Conn.**

Thermal insulations

. . . for various requirements in applications ranging from −400° to 3,000° F. are described in new 54-page Catalog IN-244A. It contains six complete sections, each devoted to a specialized group of thermal insulations. Included are industrial and high temperature, insulating firebrick and refractories, finishes and weatherproofing materials, and miscellaneous insulations.

Sections are thumbtabbed for easy reference. Information on each product consists of an application photo, description, available forms or types, advantages, and detailed specification data, including compliance with government specifications and ASTM standards. Source: **Johns-Manville Sales Corp., 22 East Fortieth Street, New York 16.**

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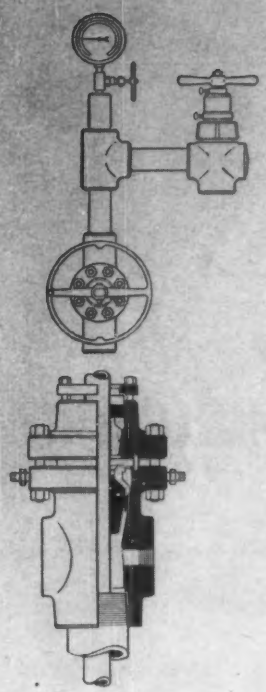

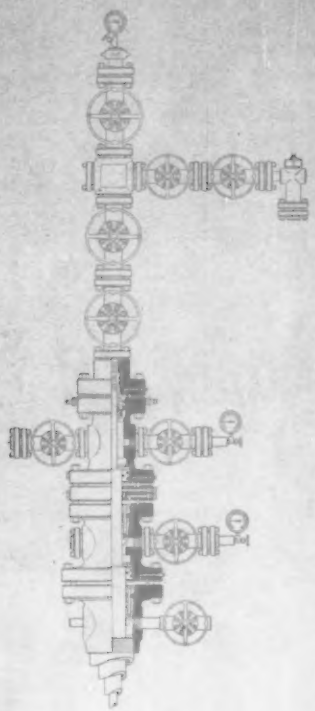

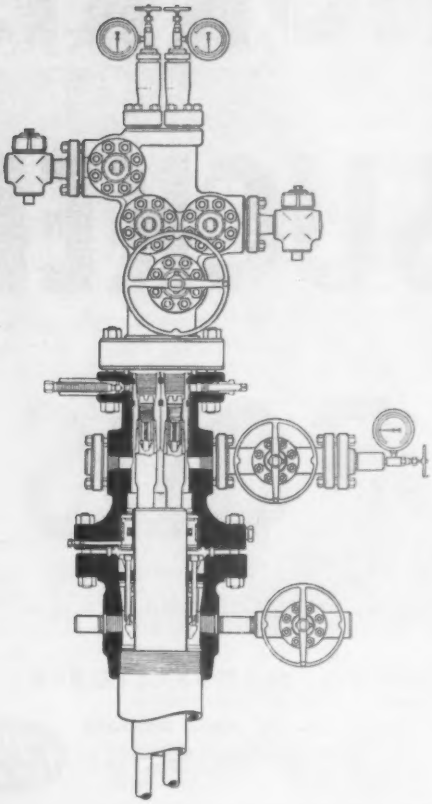

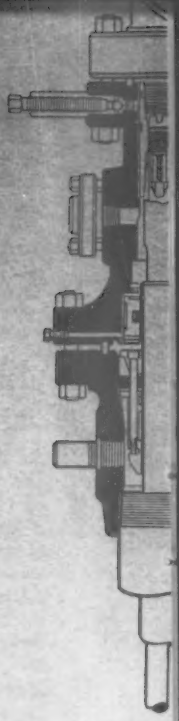

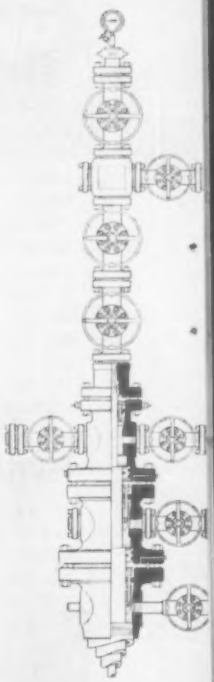

When you buy Christmas Trees ask this simple question.

WHOSE TREES ARE THESE?

It seems ambiguous, but the answers may surprise you. Ordinary trees composed of parts from several sources are a distinct disadvantage. They mean more connections, more parts, more weight and more confusion. Responsibility for performance is divided. Repairs mean parts must come from a variety of manufacturers.

Cameron Trees are different — these are our trees. From molten steel to final test, these trees are all-Cameron. Every single part reflects almost 40 years of continuous design development and manufacturing refinement.

It is not surprising that this system produces a better product — trees for any well which afford the most in safety, service, and economy.

Next time you order trees, get all-Cameron trees. They are available wherever you need them.

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Equipment Men Notes

Warren and Grundy are elected

Dow Warren

. . . directors of Reed Roller Bit Co., and William E. Scarborough becomes vice president of sales, announces John Maher, president. Warren is administrative vice president and Grundy is vice president of operations. Dow Warren first came to Reed in 1936 as an engineer in plant engineering, later becoming plant engineer. In 1942 he went to the Transmission Division briefly as production manager, then as personnel director. The next year Warren became assistant to Reed's president, a position he held until 1947 when he resigned. He returned in 1952, served briefly as manufacturing engineer and assistant to the president before being elected administrative vice president.

J. A. Grundy

W. E. Scarborough

J. A. Grundy joined Reed in 1937 as an engineer, left the company in 1939, and returned in 1942. He advanced through positions in the Transmission Division, becoming engineer, assistant purchasing agent, and finally production manager. In 1945 Grundy became production manager of the Oil Tool Division and then materials manager, assistant factory manager, and factory manager.

Scarborough was appointed domestic sales manager in 1959, the appointment representing a second association with the company. He was in Reed's engineering department 20 years, leaving in 1956 to join Security Engineering Corp. in Dallas.

Otis Engineering Corp.'s production-packer sales force meets

. . . in Dallas for a 2-day sales meeting. The gathering followed Otis' recent expansion of production equipment to include sales and service of production packers and bridge plugs. Sitting from left are: C. W. McCommas, Oklahoma City; Mason Litchfield, Shreveport; Garland Diggs, Corpus Christi; Bill Bundy, Houma; Guy Gant, Texas Gulf Coast regional manager, Houston; D. J. Webster, New Iberia; Pat Loper, Houston; Charles Le Maire, Lafayette; Ken Robbins, export sales, Dallas; B. T. Richards, Corpus Christi; Charles Morehead, Hobbs; and Paul Larrence, New Orleans. Standing from left are: H. C. Otis, chairman of the company, Dallas; W. L. Hill, South Louisiana region manager, Lafayette; M. B. Roach, vice president of sales and service, Dallas; Robert McLemore, president, Dallas; W. M. Kelly, Dallas; and H. C. Otis, Jr., executive vice president, Dallas.

George W. Gregg takes over

G. W. Gregg

. . . as manager of marketing for Tube-Kote, Inc., according to George Holm, vice president and general manager. Gregg's responsibility will be to direct all domestic sales and advertising. Previously he was branch manager of the firm's Harvey, La. plant. He has been with Tube-Kote for 5 years.

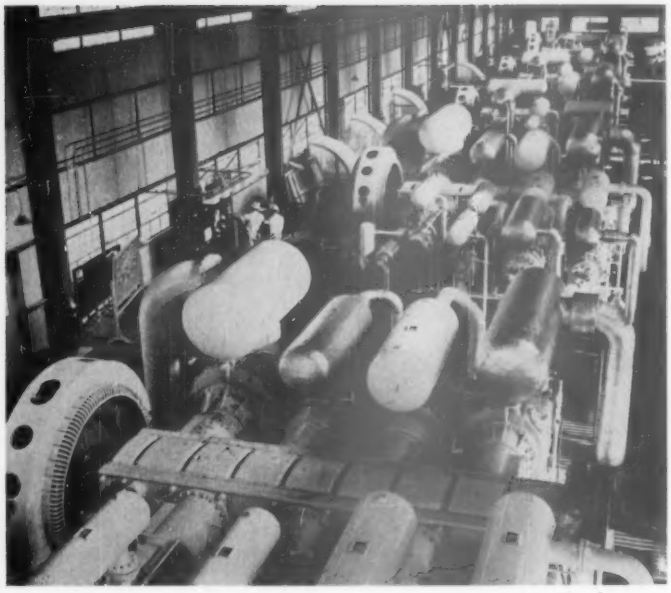
IDECO ROAD SHOW, a mobile display of oil-field drilling, servicing, and workover equipment, will visit more than 30 cities on its 5,000-mile, 4-month tour of the Southwest. The Road Show, a house trailer specially designed for mobile displays, will spend from 2 to 4 days in each city on its itinerary. Ideco, Inc., equipment on display includes working models of an H-40 Dual-Rambler rig, a Desert Rambler rig equipped with a Dualift mast, and a full-view mast. Models of the company's 10 all-steel mud pumps may be seen in the exhibit, along with a cutaway section of mud-pump valve-pot cutaway, gears, and bearings. A working model of the Ideco Duomatic dual-elevator pipe-handling system is being shown for the first time. Clutches used in Ideco Hydrair rigs are also included in the display. One trailer wall has been made into a large frame for more than 30 photographs of equipment in the field.

Lufkin Rule Co. names D. F. Oltz

D. F. Oltz

. . . to the newly created position of assistant sales manager, according to E. H. Meibeyer, vice president and general sales manager of the Saginaw, Mich. company. Oltz's former job as west-central-division sales manager will be taken over by George (Bud) Schlitt, Chicago regional manager.

Oltz joined Lufkin's sales department in 1951 and was made west-central-division sales manager in 1954.



Petroleum Chemicals, Inc., Installs 98 Burgess-Manning Snubbers To Prevent Pulsation Damage In New Ammonia Plant

Foster Wheeler Corporation was contracted by Petroleum Chemicals, Inc., to design and construct a multi-million dollar ammonia process plant at Lake Charles.

Realizing that gas pulsation would cause severe operating problems in the multi-service process piping related to reciprocating compressors, and that hazardous pulsation should be engineered out of the plant in the initial design, Foster Wheeler called upon Burgess-Manning Company to develop pulsation snubbers for various service conditions and for installation under the original contract.

Ninety-eight pulsation snubbers of 46 individual designs were installed on multi-stage, multi-service compressors. The snubbers were installed on both the suction and discharge sides of the compressor cylinders in what is believed to be *the largest single installation of pulsation snubbers under one roof.*

The compressors handle various types of gases, ranging in molecular weight from 5.13 to 33, at pressures from atmospheric to 9,270 P.S.I.A.; and at discharge temperatures to 350° F. Under these exacting conditions, Burgess-Manning accepted the responsibility to engineer and supply pulsation snubbers of optimum design that would: *1. Hold the pulse amplitude to 2 per cent or less, total surge peak-to-peak, of absolute line pressure, and 2. hold a minimum pressure drop requirement.*

The snubbers were subjected to the stringent specifications of material, workmanship, and inspection procedures normally followed by Foster Wheeler in process plants of this type. All forged snubbers for high-pressure service were made of high tensile alloy steel. Internal assemblies were engineered to withstand extreme forces.

After the plant went on stream, operational inspection revealed minimum pulsation-induced vibration, eliminating operating hazards, constant maintenance, and upkeep of the laterals, headers, intercoolers, and separators attendant to the snubbers.

If you are planning a new plant, or have a pulsation problem in your present plant, it will pay you to consult Burgess-Manning — "The Sound Engineering People." There's no obligation, of course.

Sound Engineering

INDUSTRIAL SILENCER DIVISION

BURGESS-MANNING COMPANY

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Sales Engineering Representatives Coast to Coast

He formerly was merchandise manager of the Duluth branch of Marshall Wells Co.

William I. Herod is named

. . . manager of advertising for Mid-Continent Supply Co., in which position he will work directly with the sales department in the company's Fort Worth headquarters. Herod was previously employed as an advertising space salesman for an East Texas newspaper. He joined Mid-Continent 2 years ago as advertising assistant.

Worthington Corp. establishes

. . . a new southern resale region under the managership of R. N. Franz, former central region resale manager. Headquarters will be in Atlanta and will cover the sales territories of Atlanta, New Orleans, Houston, Dallas, and Tulsa. At the same time, F. J. Reardon was appointed to succeed Franz as central region resale manager.

R. N. Franz F. J. Reardon

Franz started with the Harrison, N. J., corporation in 1949 in the Merchandising Division. He spent several years in Atlanta after being assigned to the Construction Equipment Division. In 1958 Franz was appointed regional resale manager for the central states.

Reardon joined Worthington's vertical and automotive compressor sales department in 1937. Four years later he was shifted to construction-equipment sales in Boston. Following 3 years of military service, Reardon returned to the company as New England construction - equipment representative.

B. J. Jostrand appointed veep

. . . of Larkin Packer Co., division of Koehring Co. He joined Larkin in 1927 as an accountant and was named secretary-treasurer of the firm when it incorporated in 1929. Jostrand held that office, which recently was abolished, until his recent appointment.

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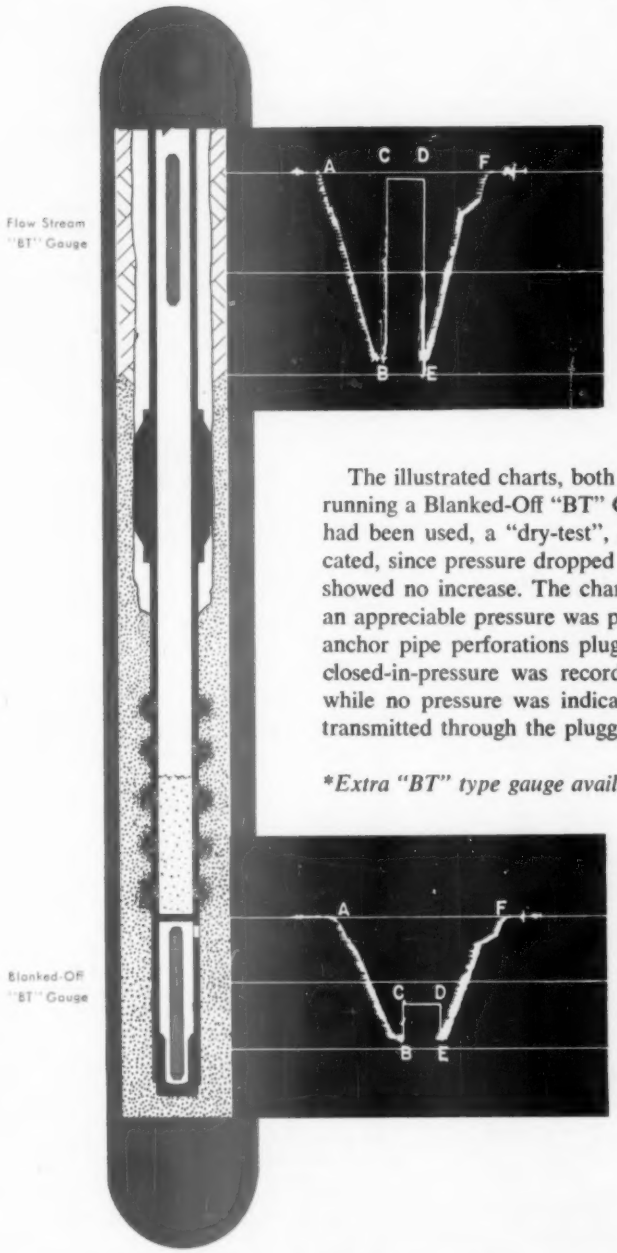
USE A HALLIBURTON BLANKED-OFF GAUGE

in your testing string



A Blanked-Off Gauge placed in a formation testing string will result in a more reliable recording of subsurface pressures.

The blanked-off gauge is isolated from fluid passage through testing string so that it records pressure in annulus below packer (see illustration).

The basic benefit derived from using a Blanked-Off Gauge on a formation test is that it reduces the possibility of passing up a productive formation which might otherwise be indicated as dry when plugging of perforations or choke occurs.

The illustrated charts, both made on the same formation test, show the results of running a Blanked-Off "BT" Gauge* in the testing string. If only flow stream gauge had been used, a "dry-test", or non-productive formation, would have been indicated, since pressure dropped to practically zero when tester valve was opened and showed no increase. The chart from the Blanked-Off Gauge, however, shows that an appreciable pressure was present in well bore below packer, thus indicating that anchor pipe perforations plugged immediately after valve was opened. Formation closed-in-pressure was recorded throughout the test by the Blanked-Off Gauge, while no pressure was indicated on the flow stream gauge since it could not be transmitted through the plugged perforations.

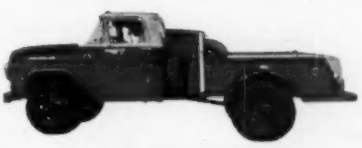
**Extra "BT" type gauge available at slight additional charge.*

For greater accuracy in formation evaluation... For Testing Results You Can Trust... call for Halliburton Testing Services... every time you program a test.

Line C-D is "Flow Period" and closed-in-pressure period. No indication is recorded of C.I.P. valve being closed as formation was already closed in by plugged perforations. Note the build-up to formation closed-in-pressure on Blanked-off gauge chart instantly after perforations became plugged.

HALLIBURTON

TESTING SERVICES



HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA

PIPELINE CONSTRUCTION

(Continued from page 225)

Ltd., Tulsa, and **John Brown, Ltd.,** London.
Completion: January 1, 1962.

Shell-BP Petroleum Development Co. of Nigeria, Ltd., 38/39 Marina, Lagos, Nigeria.
★Project: 18 miles of 12-in. line from Port Harcourt to port facilities under construction at Bonny, Nigeria.
Status: Under way.
Constructor: **African Construction Co.**

South European Pipeline Co. (Jersey Standard, Caltex, Shell, British Petroleum, and 12 other firms.)
Project: 419 mile 30-in. line from Lavers, near Marseille, to Strasbourg, with 40-mile extension to Karlsruhe, Germany.
Status: Construction to get under way by January 1961.
Completion: 1962.

Superior Oil Co., Los Angeles.
Project: A 16 and 24-in. line from its Lake Maracaibo, Venezuela, production to shore.
Status: Planned.
Contractor: **Pipe Line Technologists, C.A.,** Maracaibo, has design.

Syrian Pipeline, Damascus.
Project: 500-mile line from Karshuk field, Syria, to Mediterranean.
Status: Proposed.

Union of Soviet Socialist Republics.
Project: 2,315 miles of 28-in. Trans-Siberian crude-products line from Ufa and Tuimazy fields in Bashkiria to Irkutsk near Lake Baikal.
Status: Under way.
(See Eastern Block for information on new East Europe line).

Yacimientos Petroliferos Fiscales (Argentina), Buenos Aires.
Project: 390 miles of 14-in. from fields in Neuquen Province, Argentina, to Bahia Blancha on the coast.
Status: Bids requested.
Project: 625 miles of 12-in. from Mendoza to San Lorenzo.
Status: Planned.

Yacimientos Petroliferos Fiscales Bolivianos, La Paz.
Project: 407-mile 12-in. line from Camiri to Sica Sica.
Status: Planned.

Foreign Products Pipelines

Arabian American Oil Co., Dhahran, Saudi Arabia, and 505 Park Avenue, New York.
★Project: 30 miles of 8-in. LPG line from Abqaiq to 'Ain Dar.
Status: Planned.
Contractor: Company personnel.
Completion: 1961.

Esso Petroleum Co., Ltd., 36 Queen Anne's Gate, Westminster, London, S.W. 1, England.
Project: 70-mile ethylene line from the Fawley refinery to a new petrochemical development at Severnside.
Status: Planned.

Estrada Ferroviaria Santos a Jundial, Sao Paulo, Brazil.
Project: 25 miles of 6-in. ethylene line from Cubatao to Rio Grande.
Status: Pending approval.
Contractor: **Techint, Inc.,** Milan, Italy.

National Iranian Oil Co., Teheran.
Project: 510 miles of 8-in. eastward from Teheran to Meshed, Iran.
Status: Under way.
Contractor: **Williams Brothers,** Tulsa, has contract for about half this project.

North Atlantic Treaty Organization (Bid details from Bureau of Foreign Commerce, U. S. Department of Commerce, Washington).
Project: 57 miles of 8-in. in Germany to Land Baden-Wuerttemberg air field.
Status: Planned.
Project: 93 miles of 6-in. in Turkey.

Petroleos Mexicanos.
Project: 291 miles of 8-in. from Torreon to Chihuahua.
Status: Planned.
Completion: March 1961.

Pipelines of Puerto Rico, San Juan.
Project: 95 mile 8-in. line from Commonwealth Oil refinery at Penuelas to Catano in the vicinity of San Juan.
Status: Approved by Puerto Rican Public Service Commission.

Syrian Pipeline.
Project: About 310 miles from a new refinery at Homs to tank farms in the Damascus, Aleppo, and Latakia areas.
Status: Bidding deadline past.

Union of Soviet Socialist Republics.
Project: 2,315 miles of 28-in. Trans-Siberian crude-products line from Ufa and Tuimazy fields in Bashkiria to Irkutsk near Lake Baikal.
Status: Under way.
★Project: 700 miles from Novo-Kuibyshev refinery at Kuibyshev on Volga River to Bryansk in western Russia.
Status: Under way.

Yacimientos Petroliferos Fiscales (Argentina), Buenos Aires.
Project: 652 miles of 10-in. from Lujan de Cuyo to Buenos Aires.
Status: Planned.

Foreign Natural Gas Pipelines

Arabian American Oil Co., Dhahran, Saudi Arabia, and 505 Park Avenue, New York.
★Project: 15 miles of 14 and 16-in. from Abqaiq separator plant No. 3 to AD-1 line.
Status: Planned.
Contractor: Company personnel.
Completion: 1961.

Creole Petroleum Corp., Caracas, Venezuela.
Project: 17 miles of 30-in. and about 5 miles of 16, 20, and 24-in. from Lake Maracaibo flow stations to conservation plant Bachaquero 1.
Status: Planned.
Completion: September 1960.
Project: 22 miles of 12-in. from conservation plant Bachaquero 1 at Lake Maracaibo to conservation plant Tia Juana 2.
Status: Planned.
Completion: June 1960.

Iraq Government.
Project: A natural-gas line from Rumaila oil field to Basrah.
Status: Iraq expected to call for bids soon.

Mene Grande Oil Co., Caracas, Venezuela.
Project: 19 miles of 12-in. from East Soto to Zapatos.
Completion: 1960.

Pakistan Petroleum Co.
Project: 145 miles of 8-in. high-pressure line from Sylhet field to Daccq, East Pakistan.
Status: Proposed.

Petroleos Mexicanos.
Project: 483 miles of 24-in. from Jose Colomo field in State of Tabasco to Mexico City.
Status: Under way.
Contractors: **Condusa** is contractor. Contracts for eight river crossings on the projects were awarded to **Collins Construction Co.,** Port Lavaca, Tex., and **Constructora Inde S. A. de C. V.,** Mexico City.
Completion: November 1960.

Project: 200 miles of 14-in. from Mexico City to Salamanca.
Status: Planned.
Completion: September 1961.
Project: 291 miles of 12-in. from Torreon to Chihuahua.
Status: Planned.
Completion: March 1961.

SN Repal.
Project: 327-miles of 24-in. from Hassi R'Mel gas field in Algeria to the Mediterranean ports of Algiers and Oran.
Status: Construction expected to start soon.
Contractor: **Groupement Entrepose - Ste. Parisienne pour l'Industrie Electrique (GREP)** has contract for 200 miles from Hassi R'Mel to Tiaret.

Standard-Vacuum Oil Co., New York.
Project: 60 miles of 8-in. from Radja field to proposed ammonia plant near Palembang, Sumatra.
Status: Planned.
Completion: Ammonia plant is scheduled for completion in 1962.

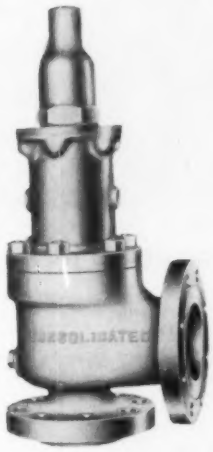
Union of Soviet Socialist Republics.
Project: Two parallel, 40-in. lines, each over 1,300 miles long, from Gazli, near Bukhara, northward to Sverdlovsk and Chelyabinsk.
Status: Planned.
Project: Line from Samarkand through Tashkent to Chimkent, Dzhambul, Frunze and Alma-Ata near Chinese border.
Completion: Line from Samarkand to Tashkent expected to be finished in 1960. Completion of rest of line expected by 1965.
Project: Line from Berezovo field southward to Sverdlovsk.
Status: Proposed.
Project: 438 miles from Dashava in Carpathian Mountains to Minsk.
Status: Under way.
Completion: 1960.
Project: Line from Minsk northward to Baltic Sea area.
Completion: To Vilnius, Lithuania, in 1961; to Riga, Latvia, in 1962.
Project: Line from Minsk northeast to Leningrad.
Status: Proposed.
Project: 405 miles from Saratov north to Gorki via Penza.
Status: Under way.
Completion: 1960.
Project: 800-mile, 32-in. loop of existing line from Stavropol fields in northern Caucasus to Moscow.
Status: Under way.
Completion: 1960.
Project: 800-mile, 40-in. line from Krasnodar fields north of Caucasus Mountains to Serpukhov, south of Moscow, via Rostov and Lugansk.
Status: Under way.
Project: 500-mile line from Shebelinka field in eastern Ukraine to Odessa and Kishinev.
Status: Under way.
Project: 310-miles of 32-in. line ringing Moscow at radius of about 50 miles.
Status: Under way.
Completion: 1962.

Venezuelan Atlantic Transmission Corp., Caracas.
Project: 10 miles of 16-in. loop from La Yaguara to Tacagua Junction.
Status: Under way.
Contractor: **William Brothers Co.,** Tulsa.
Completion: May 1, 1960.

Yacimientos Petroliferos Fiscales (Argentina), Buenos Aires.
Project: Line from Comodoro Rivadavia to Buenos Aires with a spur to Plaza Huincul field in Neuquen province. Line will be 26-in. to the connecting point for the Plaza Huincul link and 30-in. from the connection to Buenos Aires.

top

CONSOLIDATED SAFETY RELIEF VALVES have a special "O" Ring Seat Seal that stops leakage completely



Consolidated Safety Relief Valves are available in both Standard and Balanced Bellows design for extreme corrosive applications.

tightness

The Seal is a resilient ring set in the valve disc. It maintains no-leak tightness by contact with a specially curved seating surface on the valve nozzle, yet does not carry the seat load imposed by the valve spring.

Tightness is maintained at operating pressures far closer to set pressure than with metal-to-metal seats alone. Tight closure is as efficient after "simmer" as on normal blowdown. Piping strains are absorbed far better by the resilient seal than all-metal seating. If the tough seal is ruined by entrained abrasives, replacement is easy. Seals are available in materials that resist corrosive fluids. Maintenance costs are greatly reduced.

Standard Consolidated Safety Relief Valves have an eductor tube that removes pressure from the closed bonnet. Only the spring controls valve action. You get guaranteed capacity ratings and highest dependability—absolute protection for personnel and equipment. Additionally, there is the economy of converting the Standard valve to the Balanced Bellows type in your own shop. Get complete details. Write for Bulletin 1940.

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NEW WRIST PIN AND PITMAN CONNECTION . . Permits faster field assembly and speeds up changing stroke length. Pitman attaches to wrist pin bearing housing with through bolts. Tightening the bolts brings the parts together accurately and simply.

NEW BEARING ASSEMBLIES . . Pre-lubricated and sealed structural bearings eliminate contamination from field greasing (an optional feature). All bearing applications are based on manufacturer's B-10 life ratings.

QD SHEAVES, STANDARD . . available anywhere, these sheaves are lower in price than special sheaves.

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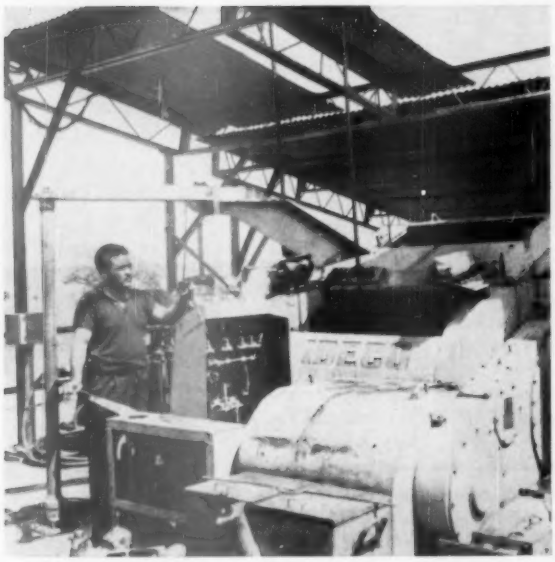

MEXICAN CONTRACTOR rig is all-new equipment.

RIG near Tampico is owned by Perforadora Cerro Azul, S. A.

Drilling contractors find action in Mexico

DRILLING CONTRACTORS are on the move in Mexico. The new industry, comprising several private companies, now operates a total of 38 drilling rigs throughout that country.

This new trend has been under way for the past 2 years. It was begun under the administration of Antonio J. Bermudez, former director-general of Petroleos Mexicanos. This policy is now being expanded by the present director-general of Pemex, Pascual Gutierrez Roldan.

Drilling contractors are now being offered all the contracts they can handle for development drilling. Pemex, with 96 drilling rigs, is still doing its own wildcatting. As these new contractors gain experience and responsibility, they will probably be assigned wildcat wells in the future. In fact, the policy in Pemex today seems to be pointing toward greater and greater use of contractors.

The new companies are being formed mainly by ex-Pemex men, primarily with Mexican capital. Some of these contractors obtained their own capital from contracts they have held with Pemex in the past. Some of them are still operating steam rigs, especially in the southern area, but each month they are buying new rigs of the latest diesel-powered design.

The contractors pay the same rates to their labor as does Pemex. However, they are able to attract Pemex crew men because they can offer bonuses for footage. The result is that contractor jobs on the average are drilled more efficiently than Pemex can drill them. As a result, Pemex also saves money and is actively encouraging this new industry.

In the Mexican Isthmus, drilling contractors are now operating 9 rigs and plan to add 12 more this year. In the fields near Poza Rica, they have 11 rigs, including 5 steam rigs, and plan to bring in 2 new mechanical rigs this year. The remaining contractors' rigs are active in the Tampico and Reynosa areas in the northern part of Mexico.

Contracts are let on a footage and day-work basis.

An important factor in the drilling industry in Mexico is a new drillers' school at the Instituto Tecnologico Regional de C. Madero. This school offers a 3-year subprofessional course. It now has 100 students and has graduated 37. The school, 4 years old, uses modern drilling equipment in the laboratory. Some of this equipment includes cutaways of packers, testers, fishing tools, whipstocks, christmas trees, etc. Its laboratory equipment is incomplete, however, and the school director will welcome any suitable equipment manufacturers might wish to provide.

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DRILLING EQUIPMENT

Baker's New Snap-Set Duals

—the packers that are bringing single-zone control and simplicity to dual completions

A Baker dual-string completion approaches the control and simplicity (and the flexibility) of a single-zone completion. What makes this possible? Mainly the development of better upper retrievable packers—Baker's new Snap-Set Dual Packers. Operators all across the country are commenting on their impressive performance.

What makes a good dual-string packer? Several things, starting with the ability to (a) set and unset readily and repeatedly; (b) pack off and retrieve easily; (c) hold a dependable packoff even when pressures and temperatures are high.

Do Baker's new dual packers do these things? They do. This is easy to understand when you consider Baker's vast experience with high performance retrievable squeeze packers. The Baker Full-Bore Cementer, for instance, has seen action in thousands of successful high pressure cementing, frac, and testing operations. This squeeze packer experience has made important contributions to the design of these new dual production packers.

That's only a brief look at the story of these remarkable packers. A few more of the interesting facts are spelled out by the pictures and text below. For a complete fill-in on Baker snap-set duals and the hookups they're used in, consult Baker's field staffs and send for literature.

FACTS ON PLANNING DUAL-STRING COMPLETIONS

Baker field staffs have all the latest facts and figures on Baker's intensive continuing study of dual-string completions. They will welcome your inquiries. We will also be glad to send you the latest literature. Please write Baker Oil Tools, Inc., P.O. Box 2274, Terminal Annex, Los Angeles 54, California.

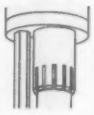
TWO BASIC MODELS. Model J (Product 756-J) is long-string set. Model K (Product 756-K) is short-string set. Both come with or without hold-down buttons (double or single grip). The pictures show single-grip Model J.

WHAT MAKES A GOOD DUAL PACKER?

The text above tells some of the things that are important. Here are a few more of the facts, starting with big unrestricted bores. Big bores are important because they permit you to run instruments and workover tools. These are probably the largest bores it's possible to design into a dual packer. For instance, a Baker dual packer for 7" casing is full-opening for two strings of 2⅜" tubing.

POSITIVE PACKOFF AND RELEASE

This three-element packing element design achieves a positive and lasting packoff with minimum set-down weight. It also simplifies release when you want to reposition or retrieve. What makes this possible is that the design prevents packing element extrusion without using the conventional metallic back-up rings that sometimes stick to the casing and defeat retrievability.

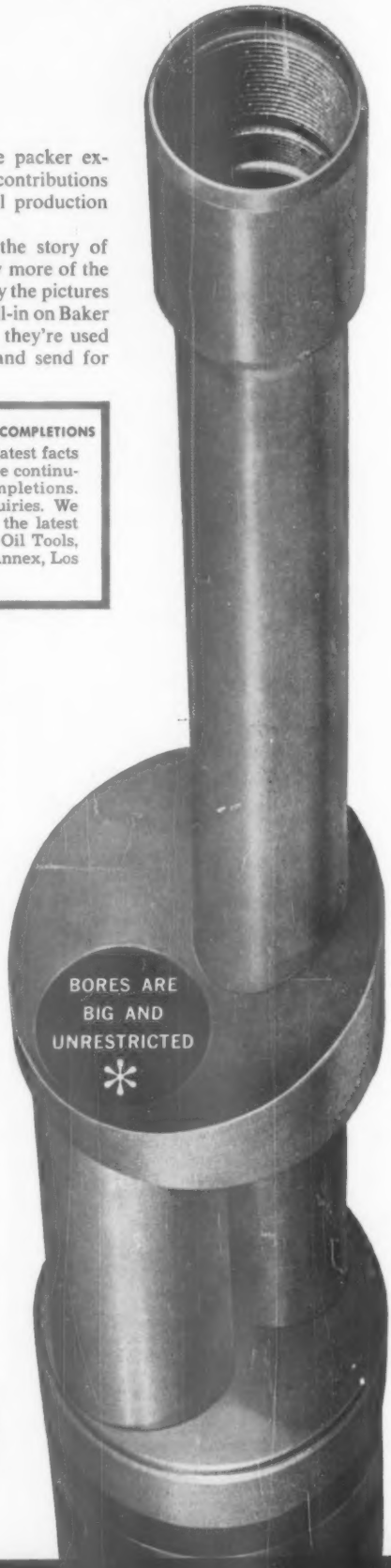


WHY SNAP-SETTING IS IMPORTANT

This simple snap-latch is what makes a Baker dual packer so easy to set and unset repeatedly. There are no one-shot shear pins. There's no ball dropping, no pressuring, no rotation. Just set down minimum weight to set packer, and pick up to release. This simplifies spacing out and enables you to test packers before displacement.

YOU CAN DISPLACE WHILE FLANGED UP

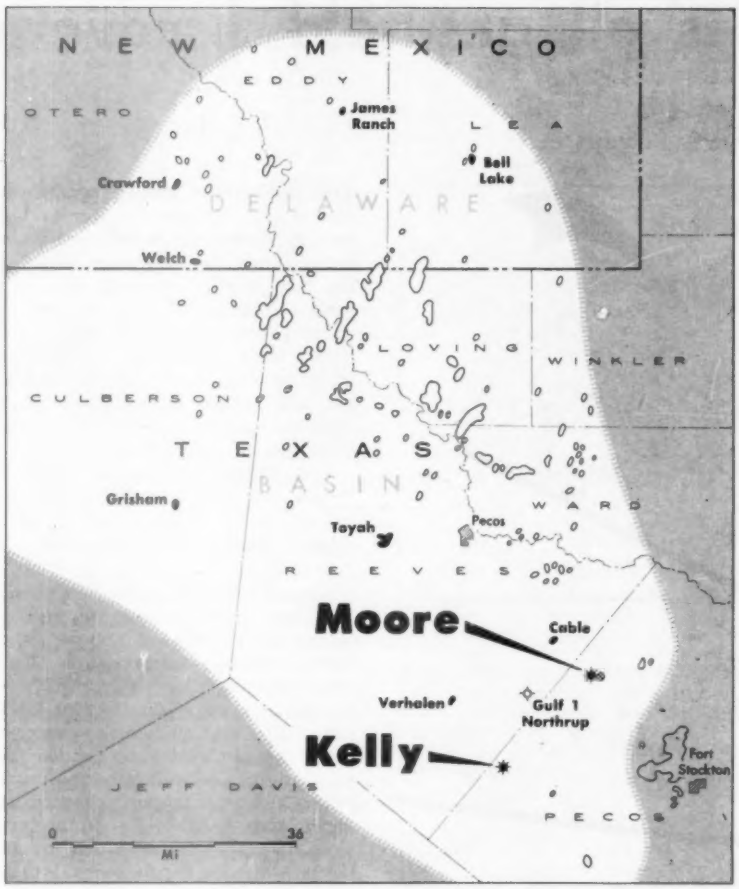
Using a side door completion valve, or sleeve valve, or other method, you can displace mud and wash in both zones with well head flanged up and under complete control.



BAKER

SNAP-SET DUAL PACKERS

BAKER OIL TOOLS, INC. HOUSTON • LOS ANGELES • NEW YORK



TWO RECENT DISCOVERIES at great depth have once more drawn attention to the deep possibilities of the Delaware basin of West Texas and New Mexico. Only five pre-Permian fields are now producing there, and four of these are on the New Mexico side. Pre-Permian areas are shown in black.

Twin strikes may revive deep Delaware interest

BY FRANK J. GARDNER

TWO RECENT STRIKES near the eastern mouth of the big Delaware basin of West Texas and New Mexico may well trigger a new era of "deep search" throughout the region. Both are located in western Pecos County, Texas.

Last summer, this column referred to the Mobil (ex-Magnolia) Oil Co. 1 Kathleen Moore as "the most important wildcat in Texas today" (OGJ, June 29, 1959, p. 123). Upon its completion a couple of weeks ago, Mobil called it "a new gas field of really significant size."

A really big well . . . The 1 Moore, in Section 19, Block 48, T-8, T&P Survey, was finished in Pennsylvanian sand at 15,041-15,147 ft. for 102,000 M.c.f. gas per day (calculated open flow) and 1,500 bbl. per day of condensate. It's the only Pennsylvanian producer in the Texas part of the basin. Four Pennsylvanian fields have been found on the New Mexico side as shown on the accompanying map.

In addition to its other distinctions, the 1 Moore startled West Texans with a shut-in bottom-hole-pressure gage of 12,590 psi., highest ever recorded out there.

The discovery first made headlines last summer when it flowed Wolfcamp oil at 10,890-95 ft. The estimated flow was 175 bbl. in 13 hours. Then, Mobil took the hole on down and at 15,017 ft. it blew out; this was the first sign that a Pennsylvanian giant was in the making. The operator sidetracked at 12,676 ft. and redrilled to the final total depth of 15,300 ft. (now plugged back to 15,256 ft.)

And a depth champion . . . About 20 miles southwest of the Mobil discovery, another pre-Permian strike is indicated at Atlantic Refining Co. 1 Kelly, Section 8, Block 51, T-10, T&P Survey. At last report, it was fishing below 19,000 ft. This one is a Devonian find, and if completed at the tested level (15,873-15,923 ft.), will become West Texas' deepest producer. The drill-stem test, made last December, resulted in a gas flow of 15,000 M.c.f. per day.

The nearest other Devonian wells are at Toyah field, 36 miles northwest, and at Puckett field, 48 miles southeast. The Toyah wells, near the basin center, are Siluro-Devonian producers at the 12,600-12,800-ft. level. Discovery well at Toyah topped Ellenburger at 13,709 ft.

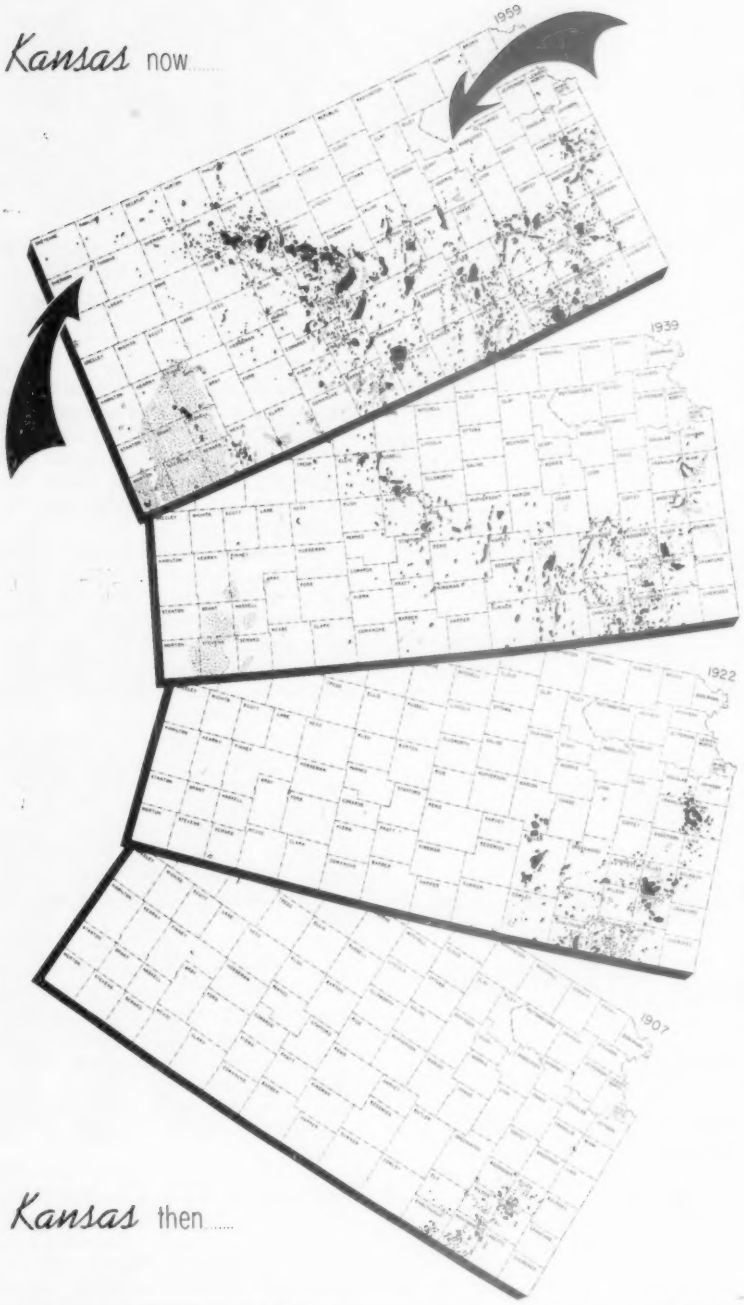
Interestingly, these two discoveries lie on both sides of the ill-fated, thrice-abandoned Gulf Oil Corp. 1 Northrup "A," a deep (18,771 ft.) failure in southeastern Reeves County, Texas (see map). This well never found the Ellenburger it was seeking and was finally finished in Siluro-Devonian.

Only four other pre-Permian fields have ever been found on Texas' side of the Delaware basin, and three of these have been abandoned (Grisham, Verhalen, and Cable). Toyah is the remaining one. The two new discoveries will raise the total to three fields . . . not much of a score for one of the largest basins in the country.

May kick off a play . . . But geologists believe that Delaware will have its day. It's no secret that most West Texas operators are just biding their time until more is known of subsurface conditions there before launching a truly big drilling attack in depth. A little more encouragement such as the Moore and Kelly wells, and the day will arrive.

For 40 of the past 56 years, Kansas has been the leading wheat-producing state of the

Kansas' oil, gas-field discoveries



OIL AND GAS-PRODUCING AREAS of Kansas for 1907, 1922, 1939, and 1959. Areas of interest in 1959 are indicated on the latest map (oil, solid; gas, stippled). Production, at first confined to eastern Kansas, later swept westward across the state, so that by 1959, there was recorded production in 86 counties. Fig. 1.

THE VALUE of mineral wealth exploited year by year in Kansas has steadily increased, with minor setbacks, since the depression days of the early thirties. Kansas, thus, has ranked in the top 10 states in value of mineral commodities produced annually since 1932, but only because of the production of crude oil, natural gas, and related products, which in 1959 accounted for about 83% of the total mineral production.

The high percentage of mineral wealth contributed by the petroleum industry serves to emphasize the value it has in Kansas' economic picture.

Annual crude-oil production of the Sunflower State exceeded 100 million barrels in 14 of the last 17 years. The 1959 production is estimated at 119.2 million barrels, which is less by about 5.3 million barrels than the peak of 1956. This was enough, however, to boost the cumulative production almost to the 3¼-billion-barrel mark (Fig. 2). The state has produced as much crude since 1945 as in the previous 85 years, indicating that the industry is meeting the challenge of fuel-devouring machines of the space age. Slightly more than 75% of the oil in Kansas has been produced from beds of Pennsylvanian and Arbuckle-Reagan (Cambro-Ordovician) age.

The quantity of oil produced monthly in Kansas to some extent reflects economic conditions of the country as a whole. However, previous to regulation and conservation—for example, flush production from the El Dorado field immediately after discovery in 1915—nearly broke the market. The demand dropped slightly until the late 1930's, when again it increased and later skyrocketed during World War II. Owing to an expanding economy and the Korean conflict, demand slowly increased until 1956, but since that time has sagged because of a

Publication authorized by Director, State Geological Survey of Kansas. This article by the authors is the third in a series on petroleum possibilities in Kansas to appear in The Oil and Gas Journal. The first, "Kansas' Structural Provinces Offer Varied Types of Traps," was printed in the April 30, 1956, issue; the second, "Alert Explorers Find Kansas Oil," and "Where's the Oil in Kansas?", was published in the March 2 and 9, 1959, issues of the Journal.

nation, producing about a fifth of the country's wheat. But for 20 of the last 30 years, mineral production—mostly petroleum—has exceeded wheat production in monetary value in the Sunflower State. Last year, value of mineral production in Kansas exceeded $500 million—for the fourth consecutive year—and was second-highest figure in the state's history.

continue to mount

BY DANIEL F. MERRIAM
and
EDWIN D. GOEBEL
State Geological Survey of Kansas

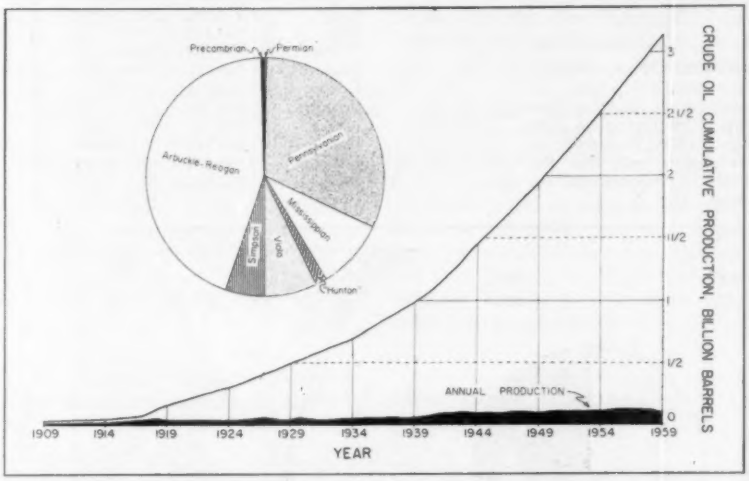
temporary oversupply brought about by many factors.

Since 1935 the oil industry in Kansas has been regulated by the Conservation Division of the State Corporation Commission, which is charged with safeguarding the state's petroleum resources against unwarranted exploitation and unnecessary waste. Monthly oil proration reports are issued by the commission for many of the state's oil fields. It is also responsible for testing productivity of new wells and supervision of dual completions, installation of packers, plugging, and setting of surface casing to prevent commingling of water or oil from different zones.

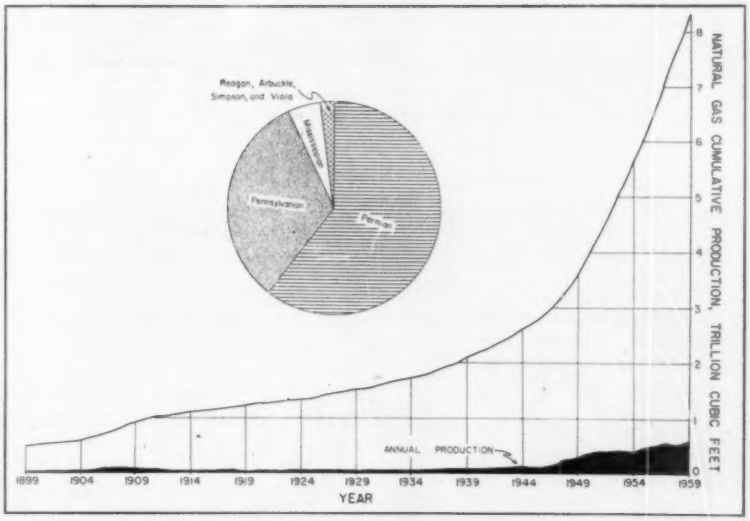
Cumulative natural-gas production of the state surpassed the 8,000,000 M.M.c.f. mark in 1959 (Fig. 3). This is a fantastic volume considering it is more than double the total production of Kansas prior to 1949 and quadruple the amount prior to 1938. Since 1956, annual production has exceeded 500,000 M.M.c.f., and since 1943 has bettered 100,000 M.M.c.f. annually. The 1959 estimated production, worth an estimated $64.6 million, is 587,600 M.M.c.f., an all-time high for the Sunflower State.

By far the greatest amount of gas has been produced from the prolific Hugoton gas area (by definition production from Permian-Chase Group beds) of western Kansas and adjoining areas of the Texas and Oklahoma panhandles. In recent years gas production from outside and stratigraphically beneath the Hugoton has been gaining in importance. Pennsylvanian beds, principally in eastern Kansas, have supplied the second-largest amount of gas, yielding about 32% of the total (Fig. 3). Lesser amounts have been obtained from beds of Mississippian, Ordovician, and Cambrian age.

Like crude oil, gas production in Kansas is regulated by the Conservation Division of the State Corporation Commission.

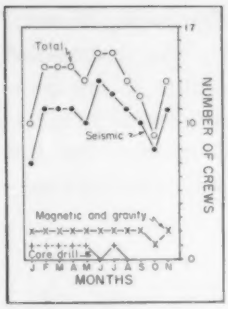


CUMULATIVE OIL PRODUCTION IN KANSAS surpassed the 3-billion-barrel mark in 1958 and reached almost 3¼ billion by end of 1959. Annual production exceeded 100 million barrels in 14 of the last 17 years and every year since 1947. Arbuckle-Reagan rocks have yielded about 45% of total, followed closely by Pennsylvanian beds with about 32%; other Paleozoic rocks have contributed the other 23%. Fig. 2.



KANSAS' CUMULATIVE NATURAL-GAS PRODUCTION rose above 8 trillion cubic feet in 1959, more than double the amount produced prior to 1949, and for the fourth consecutive year the annual production has exceeded ½ trillion cubic feet. Permian rocks, mainly in the Hugoton gas area of western Kansas, have yielded slightly more than 61% of total gas production, whereas Pennsylvanian rocks are second (32%), Mississippian rocks third (5%), and the remaining 2% is from Lower Paleozoic rocks. Fig. 3.

Leading oil-producing counties in Kansas are listed in Table 1. The information is based on production recorded and estimated to the end of 1958. Only those counties having cumulative production of 50 million barrels or more are shown. Butler County is first only because of El Dorado field (on the Nemaha anticline) which has yielded more than



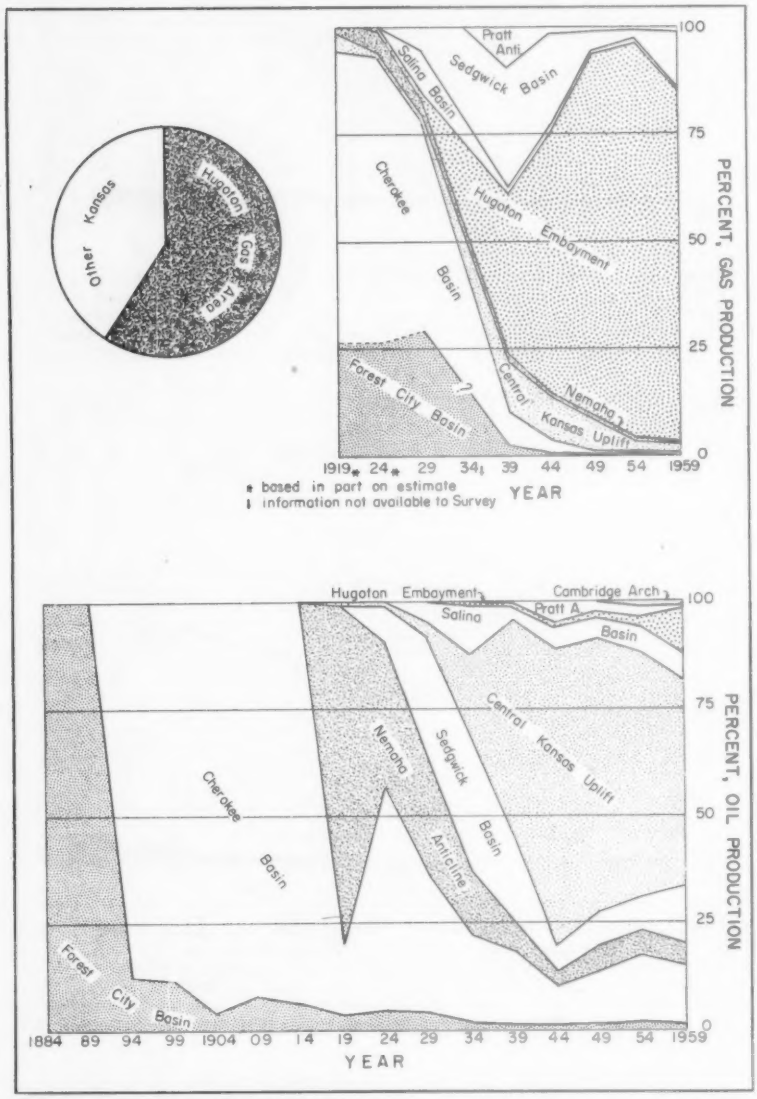
NUMBER OF geophysical and core-drill crews operating in Kansas during 1959 (based on data from IOOC). Information available only for the first 11 months of the year. Fig. 4.

TABLE 1—LEADING OIL-PRODUCING COUNTIES IN KANSAS BASED ON CUMULATIVE PRODUCTION TO END OF 1958

County	Cumulative production, bbl. 1957	1958	Rank 1957, 1958
Butler	421,872,447	429,587,001	1
Barton	309,234,420	320,785,515	2
Russell	288,526,106	297,532,091	3
Greenwood	216,575,650	223,042,369	4
Rice	215,874,697	221,189,082	5
Ellis	204,360,463	215,675,431	6
M'Phers'n	140,584,533	144,568,785	7
Stafford	126,765,181	132,617,382	8
Cowley	92,316,235	96,488,132	9
Ellsworth	89,654,208	91,774,706	10
Rooks	74,281,841	80,471,282	11
Sumner	67,069,889	70,001,482	12
Sedgwick	64,496,251	67,726,683	13
Reno	61,930,531	62,893,875	14
Graham	43,755,336	50,555,688	15

TABLE 2—NUMBER OF OIL PRODUCING COUNTIES IN KANSAS, 1860-1956

Period	Total completed	Number added
1950-1959	86	20
1940-1949	66	8
1930-1939	58	25
1920-1929	33	15
1910-1919	18	8
1900-1909	10	7
Before 1900	3	--



PER CENT OF OIL OR GAS PRODUCTION to the states' total by post-Mississippian structural province. Relation of cumulative gas production from the Hugoton gas area to the rest of the state also is shown. In 1959 the Central Kansas uplift accounted for the largest percentage of oil production in Kansas and the Hugoton embayment for the most gas production. Fig. 5.

55% of the county's total production. Barton and Russell counties (on the Central Kansas uplift) contain parts of four of the six largest fields in Kansas, thus accounting for their high ranking. Greenwood County in the Cherokee basin boasts part of the "Golden Lanes," shoestring sands of Pennsylvanian age, which have been prolific producers over the years. Graham County made the "select 15" in 1958.

Kansas has four fields, El Dorado, Chase-Silica, Bemis-Shutts, and Trapp, that can be considered giants. A fifth, Kraft-Prusa, should become a giant in about 2 years. A field is classed as a giant when production has passed the 100-million-barrel mark. Together, these five fields plus Hall-Gurney, another Central Kansas uplift field, account for almost 20% of the state's total annual production.

Exploration activity in 1959 remained high despite adverse economic conditions in the petroleum industry. An estimated 5,500 wells were drilled, about the same number as in 1958. Approximately 188 new fields were discovered, an increase of about 24% over 1958. In addition, 11 fields were revived and about 50 new zones in old fields were opened. Counties with the most new discoveries were Barton (17), Stafford and Ellis (15), Graham (10), and Butler, Meade, Rooks, and Cowley (8); these figures, however, are based on incomplete returns for the year.

Geophysical activity in the state remained at a high level during 1959. The most crews working were 15 in June and July, but the number dropped to a low for the year at 9 in October (Fig. 4). Again, as in previous years, seismic exploration accounted for most of the crews, although one gravity and one magnetic crew were reported. Seismic prospecting has had considerable success in locating new reserves (Glover, 1959) and thus is being extensively used by Kansas operators especially for locating wildcats. Therefore, seismic activity is expected to remain high during the coming year.

Geographic distribution of oil and gas-producing areas for 1907, 1922,

1939, and 1959 are shown in Fig. 1. Oil and gas production was limited to Pennsylvanian rocks in southeastern and eastern Kansas in 1907. The 1922 map reflects the shift westward of the oil development in Kansas, which resulted from deeper drilling and exploration for pre-Pennsylvanian reservoirs, especially along the Nemaha anticline. The 1939 distribution of pre-World War II oil and gas-producing areas, shown on Fig. 1, indicates the westward sweep of oil development. Between 1922 and 1939, the various pre-Pennsylvanian structural provinces were outlined by information gained from drilling. The 1959 index map depicts considerable development in southwestern Kansas and promise of important reservoirs in northwestern Kansas.

Beginning of the oil-centennial year in Kansas finds an enlivened exploratory interest in several of its structural provinces.

Northwestern Kansas, part of the Hugoton embayment, had 15 oil fields at the end of 1959, and 52 wells had been completed in the area. A lease play of major proportions took place. Of the new fields in Cheyenne, Logan, Rawlins, Sherman, and Thomas counties, nine were opened in 1959. These are Rueb, Rueb South, and Ken fields in Cheyenne County; Arbor, Cahoj, Kompus, and Wilheim in Rawlins County; Monument in Logan County; and Lanisia in Thomas County.

Ken field was opened in March by Phillips Petroleum Co. 1 Wilkens "A" well in 16-2s-37w. Initial daily potential of 83 bbl. of oil was assigned the discovery well from perforations between 4,768-96 ft. in Cherokee rocks. Rueb South field was opened by R. G. Lawton on the Liebbrandt lease, 36-35s-42w, in December. Ninety-five barrels of oil daily was recovered from Lansing-Kansas City rocks from 4,503-10 ft. Monument field in Logan County was opened in October by Texas Crude Oil and J. O. Farmer 1 Rohrs well in 18-11s-33w. Oil production is from Lansing-Kansas City rocks, through perforations from 4,325-29 ft. At last report the discovery well was waiting assignment of an initial potential.

Four Lansing-Kansas City discoveries were made during 1959 in Rawlins County. Cahoj was discovered in May, and Kompus and Wilheim were discovered in August and September; all are Skelly Oil Co. fields. Arbor field, discovered in April, is an Amerada Oil Corp. field discovery. Lansing-Kansas City production in the four discovery wells comes from depths of 4,000-5,000 ft. Of special significance in the development of northwestern Kansas is the assignment of an initial potential of 3,000 bbl. of oil per day to the Cahoj opener well. Eight other wells of the 26 completed in the field during 1959 had initial potentials in excess of 2,000 bbl. a day. Oil was discovered in Tarkio beds (Pennsylvanian) in Lanisia field, named in December upon the completion of J. O. Farmer and Musgrove Petroleum Corp., 1 Brown well in Sec. 12-6s-35w, Thomas County. An initial potential of 211 bbl. of oil was assigned this discovery well from a depth of about 3,750 ft.

Late in December a fifth oil field in Cheyenne County was indicated by promising drill-stem tests in the Saffa and Brauer 1 Weaver well in Sec. 13-4s-38w, about 10 miles northwest of Llanos field (Sherman County). Operators swabbed 24 bbl. of oil per hour for 6 hours from perforation between 4,765-70 ft. in Pennsylvanian-Marmaton rocks.

An extremely important development in eastern Kansas during 1959 was the discovery of Hunton oil in Yaege field in 11s-8e, on the western flank of the Nemaha uplift. Here, Pennsylvanian strata overlie older Paleozoic beds from west to east across the county, and lie uncomformably on the Precambrian rocks of the Nemaha uplift. Yaege field, reportedly discovered through surface studies, lies on the southern flank of a pre-Pennsylvanian high where porous Hunton rocks are unconformably overlain by the aforementioned Pennsylvanian strata. Yaege field was opened by the Cities Service Oil Co. 1 Yaege well in Sec. 25-11s-8e, in June. Initial potential of 36 bbl. of oil a day was assigned the well from Hunton rocks at a depth of about 1,700 ft. In the Cities Service 2 Yaege well in Sec. 25-11s-8e, a sandy Pennsylvanian conglomerate at a depth of 1,593 to 1,610 ft. yielded 515 ft. of oil and 180 ft. of heavily oil-cut mud from a 1-hour drill-stem test. This well, in process of completion, opens a second producing zone in Yaege field. Gravity in the field averages 33°. As of the end of 1959 Yaege had 24 completed oil wells.

Ge-See field in 27-11s-8e, Geary County, lies just southwest across the county line from the Riley County Yaege field. The discovery well was brought in on the Green lease by Adair Oil Co. Oil is produced from a Pennsylvanian sand near the Mississippian-Pennsylvanian unconformity at a depth of approximately 1,750 ft. An initial potential of 20 bbl. a day was assigned the discovery well.

Wingfield oil field was discovered by Jones & Gebert No. 2 Scott well in 35-11s-7e, Geary County, 6 miles west from Ge-See field. Production is obtained from the top of Mississippian rocks at a depth of 1,790 ft. Initial potential of 20 bbl. of oil a day was assigned to the discovery well.

In southwestern Kansas additional Mississippian and Pennsylvanian oil and gas reservoirs were opened adjacent to and stratigraphically beneath the Hugoton Gas area (Permian-Chase Group) in 1959. Development of Mississippian gas production in Sedgwick basin was accelerated during 1959 (Fig. 5).

Kansas' oil centennial year—1960—is expected to reach a new peak in recorded mineral wealth. Every indication points to continued successful exploratory activity such as that which characterized 1959. New and important petroleum discoveries, although not earth shaking, are made each year, assuring Kansas a prominent place among oil-producing states of the nation.

New pools feature Pennsylvania news

About 5 miles southeast of Ohiopyle field, discovered at the last of 1959 by the Meuller-Herr on Laurel Hill anticline, a second wildcat has been completed opening a new pool. The new strike is the State Game Tract 111-A No. 1 in Somerset County. It was drilled near a dry hole that was abandoned 2 months ago. This discovery found gas in the Onondaga chert. Open flow after fracture was 1,900 M.c.f.d. with rock pressure at 3,270 psi. in 24 hours.

In Erie County. Operations on the Borst well in this northwestern county have been suspended until spring weather arrives definitely.

In Jefferson County. A wildcat is being drilled on the southeast flank of the Hebron anticline in Jefferson County. Another test has been staked, both by Aladdin Petroleum Co.

In Warren County. The Frank Kapp well in this county is still fishing. Progress is being made with hopes of recovering fish soon.

In Clearfield County. In Boone Mountain pool additional gas producers have been drilled near the 3-mile stepout on the southeast flank of Sabinsville anticline. Wells haven't tested the area between the main field and the stepout. Some operators think this untested area may be dry.

In Northumberland. A wildcat is drilling near Sunburg at 3,245 ft. in Northumberland County.

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Illinois basin drilling shows signs of stir

There are good signs of stirring in basin oil areas with the advent of better weather. Despite the worst winter drilling conditions in many years, tristate operators have been busy.

In Richland County, Illinois, 2 miles southeast of Olney in SW SW SE 7-3n-11e, Zanetis Oil Properties set casing to test the Rosiclare Mississippian lime at 3,210-18 ft. at the 1 J. G. Scherer. A drill-stem test at 3,204-20 ft. got clean oil. The first well here was completed in May 1959 at 1 M. Gardner in SE SE NW 18-3n-11e for 161 bbl. of oil per day, pumping and flowing from Rosiclare at 3,215-20 ft.

Coles County has a new Rosiclare producing area 3 miles north of the City of Mattoon. Development Associates opened the play in January. The 3 George Miller in NW SW SE 22-13n-7e made 89 bbl. per day from 1902-15 ft. William ZuHone Jr. 1 W. H. Tracy in SW NW. SE made 84 bbl. per day from 1904-12 ft. Two other wells are to be completed by this operator.

Four Illinois extensions in February

Four extensions to oil pools in Illinois were reported in February.

There was one extension to each of the following pools: Whittington West in Franklin County, Clay City Consolidated in Jasper County, and Mount Erie North and Johnsonville Consolidated in Wayne County.

No new oil or gas pool was discovered in the state during February.

Two of the wells completed in February were drilled below 4,000 ft. Maryland Service Co., Inc., drilled its 1-S E. F. Kircheis in 27-3n-6w, in Madison County, to a total depth of 5,019 ft. in the granite. It was completed as a dry hole. Tamarack Petroleum Co. 1 F. T. Brach, 3-1s-7e, Wayne County, was drilled to a total depth of 4,140 ft. in the Warsaw formation. It was plugged back to 3,209 ft. and completed as a producer in the McClosky limestone.

North Dakota's Glenburn field extended south

More extension success is reported at Glenburn field in North Dakota's Renville County. The California Co. 2 Laughlin in SW SE 18-158n-81w, got oil on drill-stem test at 4,519-35 ft. This well is 1 mile southwest of the 1 Laughlin, recent stepout success. The new success will give the field a 3-mile north-south trend.

"Our men like to use Edward Mudwonder Valves...

...what more could you ask for?"

Ray Bounds, Tool Pusher for the Bay Drilling Corp., Thibodeaux, La., has an excellent reason for using Edward Mudwonder valves on the Drilling Barge Rome. Here's what Ray says:

"We've just drilled seven holes in ten months. And we're ready to start on number eight as soon as we get on location. If you know Southeast Louisiana, you know that these are deep wells—13,000 footers—and working pressures sometimes hit 2800 pounds. To keep up a schedule like this means we have to have high-class equipment and good crew morale. *Having good equipment is the biggest morale booster we have.*

"Our Mudwonder mud valves are the kind of equipment the men like to use. Mudwonders are easy to open and close even at high pressure with heavy mud and seventy pounds per barrel of lost circulation material. If our Mudwonders need to be inspected or serviced, the men can tend to it quickly without removing the valves from the line. What more could you ask for?"

The confidence Ray Bounds has in Edward Mudwonder valves is found wherever you go in the drilling fields. Mudwonder valves are built in 2", 3" and 4" sizes, with screwed or flanged ends, for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test) service and in 2" size for 5000 psi WP (10,000 psi test) service. See your favorite oil field supply store, or write Edward Valves, Inc., 1212 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company.

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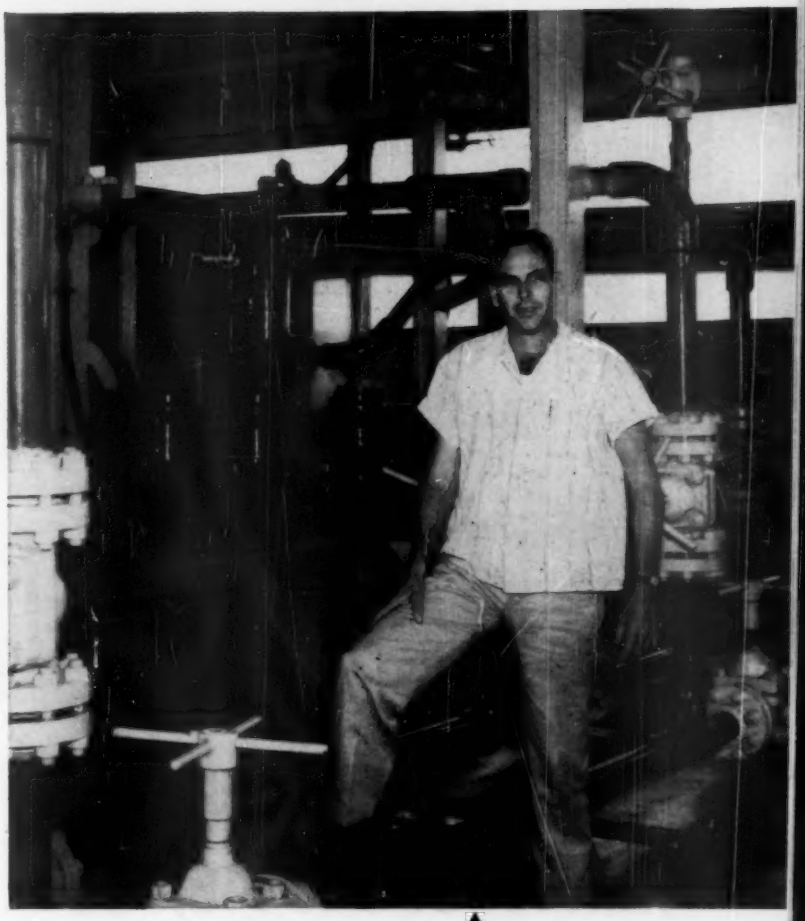
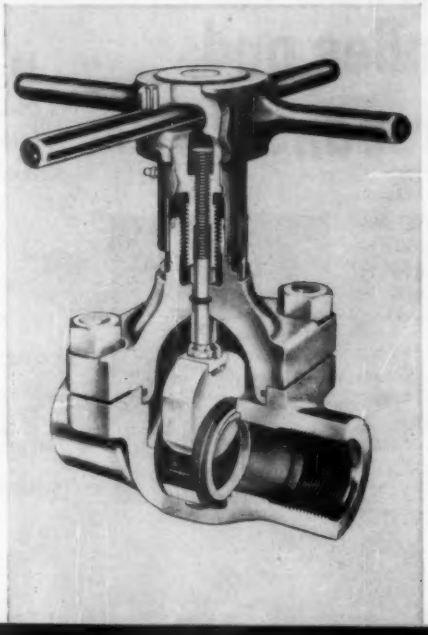


▲ Ray Bounds, Tool Pusher for the Bay Drilling Corp., finds that his men like Edward Mudwonder valves because they are easy to operate and easy to maintain.



◀ Mudwonder cut-away view shows the one-piece seat insert with Buna-N molded integrally over steel wear rings; chromed gate with "T" slot connection; separated stainless stem and double thread construction.

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The Rayflex Exploration Co. of Dallas serves the petroleum industry throughout the United States from Canada to the Gulf, and operates overseas as well. At the present time it has seven crews in the field.

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"We have all Ford Trucks except for our 4 x 4 pickups, and now that Ford builds this type of unit we'll probably be 100% Ford in the future."

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DISCOVERY of Smackover production in northern Cass County forges another link in East Texas' developing chain of Jurassic fields.

Remote Texas wildcat hits Smackover oil

TEXAS' sparsely explored northeastern corner blossomed out this week with a rich gas-condensate discovery from its up-and-coming deep Jurassic horizons.

In northwestern Cass County, it is nearly 20 miles from any other oil or gas field. It is the second Jurassic discovery in East Texas this year.

Discovery well, drilled by Shell Oil Co. and Cities Service Oil Co., joint operators, flowed at the rate of 3,900 M.c.f.d. of gas through 20/64-in. choke. Gas yielded 200 bbl. of 59°-gravity condensate per 1 M.M.c.f. Flowing pressure was 2,500 psi.

Pay zone is in the Smackover formation, lower Jurassic member, perforated at 10,297-10,352 ft. and 10,358-67 ft. Total depth is 10,603 ft.

This is the fourteenth field in which Jurassic production has been found in East Texas, a region in which dominant production has been from the shallower Cretaceous horizons. Ten of these fields produce from the Smackover, and four from the more elusive, younger Cotton Valley member.

Completion of the Cass County discovery well, 1 V. B. Allsup, follows within a month Pan American Petroleum Corp.'s Cotton Valley gas-condensate discovery near Fruitvale, in Van Zandt County (OGJ, Feb. 8, p. 69). The latter is 90 miles southwest of the new well.

Drilling for gas at Arbuckle booming

Two good producers, one a 1-mile extension, highlighted recent drilling in Colusa County's Arbuckle gas field in Sacramento Valley. A drill-stem test on an Occidental Petroleum Corp. extension indicated a potential of 3,410 M.c.f.d. for the well. The sand tested was at 6,156-70 ft. This well is located 1 mile north of production.

In the main producing area, Western Gulf Oil Co. tested a zone at 5,688-93 ft. for 2,576 M.c.f.d. in a well being drilled in NW NW 34-14n-2w.

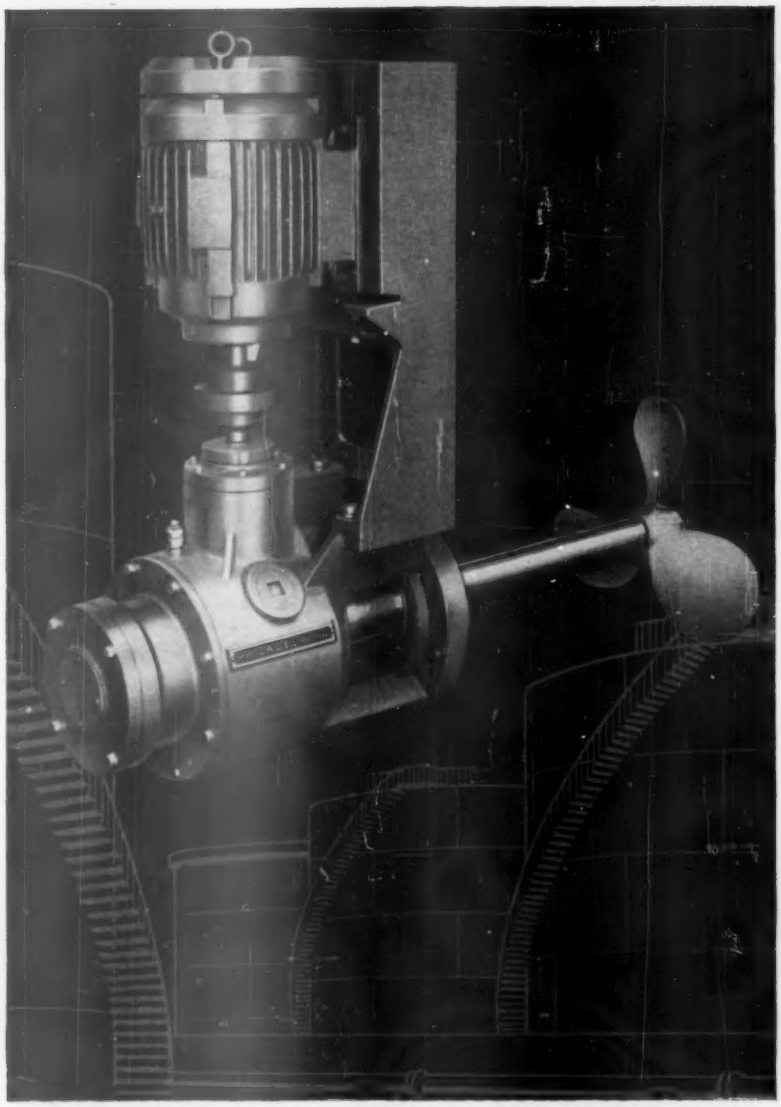
In addition to its 1-mile-north extension, Occidental had two more sites staked for significant tests in the field. One was scheduled as a deeper pool 12,000-ft. test in the main area. The previous deepest test in the field bottomed at 7,500 ft.

Occidental also had a location staked for what will be the northeasterly test in the field.

Oklahoma's Beaver bags dual gas discovery

Dual gas production in Morrow and Chester is reported at a wildcat in Oklahoma's Beaver County in the Panhandle. The discovery is Sinclair Oil & Gas Co. 1 Edwin A. McGrew Unit. Location is 4½ miles southeast of Beaver town and 1 mile west of Mocane field production.

Flow was 24 bbl. condensate and 2,828 M.c.f.d. Flow was on 30/64-in. choke from upper Morrow sand at 6,688-6,714 ft. The Chester Mississippian at 6,996-7,040 ft. gave 36 bbl. condensate per day and 3,305 M.c.f.d. on ¾-in. choke. Nearest Chester gas is 3 miles north. Nearest upper Morrow production is 6 miles northeast at Mocane.



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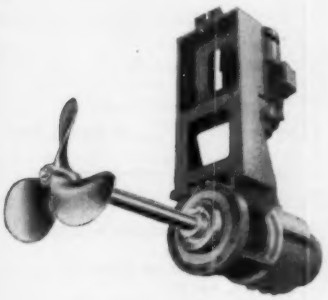
SIDE ENTERING MIXERS

And there is plenty that's *new* about them. Shorter, more compact; they minimize the need for mounting braces. Reducer and reducer support stand housing is one piece to provide more rigid support for bearings, shafting and gearing. In short, these new mixers are designed for the job . . . not adapted to it. They overcome all the problems inherent in mixers that are a collection of components designed for other purposes.

And if you are looking for better mixing, these new Philadelphia mixers will deliver it. Large volumetric flow means thorough top-to-bottom turnover, even in the largest tanks. As for cost, Philadelphia side entering mixers cost less than *any mixer* of comparable quality.

NEW
FROM EVERY ANGLE



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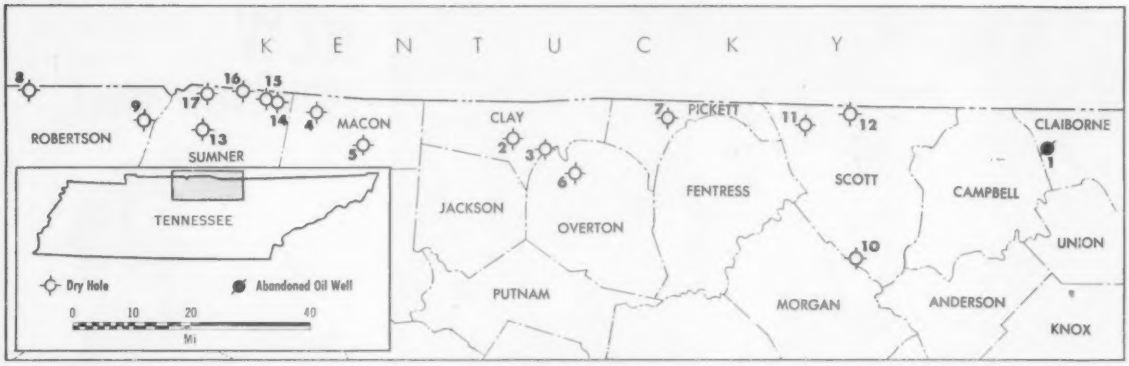


1. Tenn. Development Project, Amer. Assoc. No. 1
2. Gathing et al., Smith No. 1
3. Pennsylvania Railroad, Swan Brothers No. 1
4. Hawks et al., Jones No. 1
5. Macon Oil & Gas Co., Morgan No. 1
6. Flaws et al., Hunter No. 1
7. Shaeffer et al., Williams No. 1
8. Heathcote et al., Carroll No. 1
9. Hawks et al., Goosetree No. 1
10. Midland Corp., Baker—Payne No. 1
11. Diversa Prod'g. Co., Scott Land Co. No. 1
12. Diversa Prod'g. Co., Swain No. 1
13. Hawks et al., Denning No. 1
14. Fred Rowe, Eaton No. 1
15. Oglesby & Duncan, Fleming No. 1
16. Britt et al., Lear No. 1
17. Obermeyer et al., Roberts No. 1

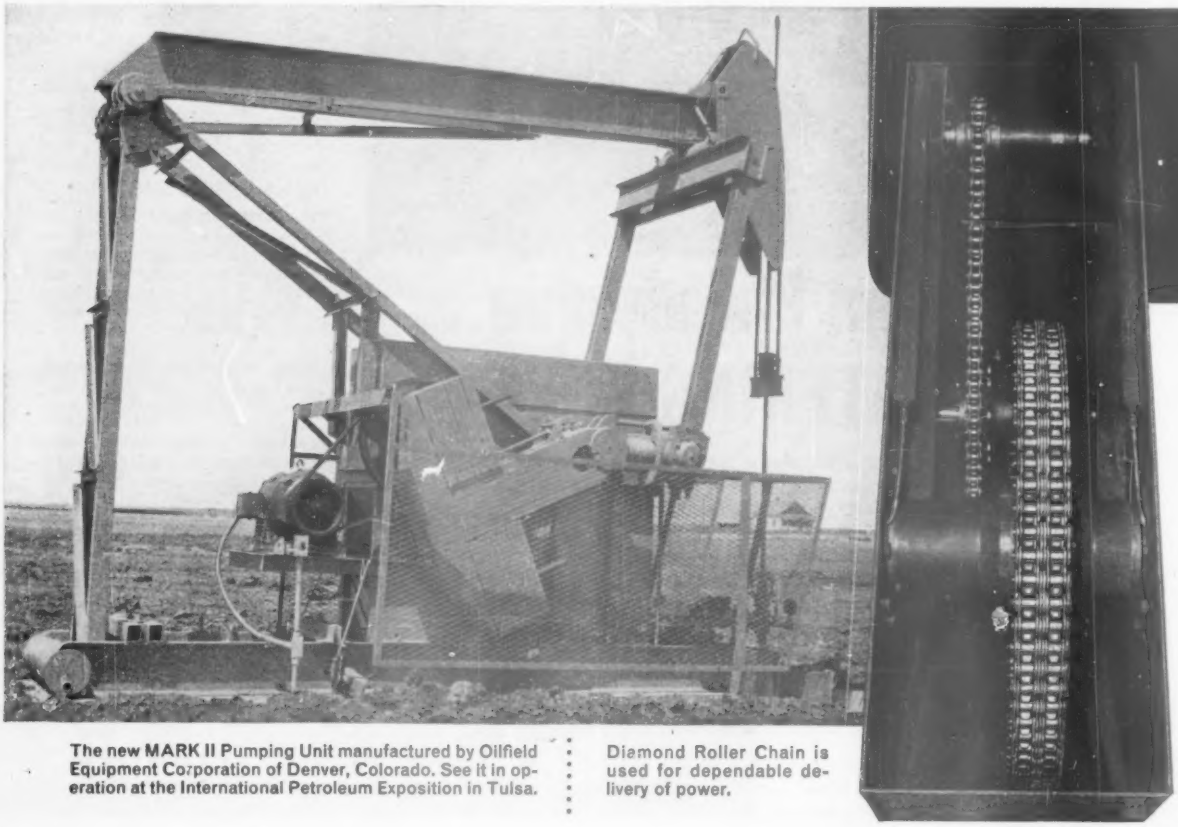
THESE IMPORTANT WILDCATS sparked Tennessee's drilling surge last year.

Tennessee wildcatting triples in '59

THE 72 TEST wells drilled in 1959 were almost three times the number completed in 1958. Four small oil wells were discovered and one new gas well was still shut in at the end of the year. Total exploratory footage was approximately 56,600 ft. New leasing activity is estimated to have doubled or tripled the acreage under lease a year ago.

Developments

At least 72 test wells were drilled in Tennessee during 1959 and were distributed across the northern half of Middle Tennessee and into East Tennessee. The average depth of less than 800 ft. per hole shows that most of the tests were aimed at shallow pays and with few exceptions they were drilled in areas of old



The new MARK II Pumping Unit manufactured by Oilfield Equipment Corporation of Denver, Colorado. See it in operation at the International Petroleum Exposition in Tulsa.

Diamond Roller Chain is used for dependable delivery of power.

IMPORTANT WILDCATS IN TENNESSEE

Map No.	County	Operator and location	Total depth	Surface formation	Deepest zone tested
1	Claiborne	Tenn. Development Project, 21-A 67e	3,503	Penn., L.?	Ord., U.?
2	Clay	Gathing et al., 12-A 48e	1,600	Ord., M.	Ord., L.
3	Clay	Pennsylvanian Railroad, 16-A 50e	1,300	Miss., L.	Ord., L.
4	Macon	Hawks et al., 22-B 41e	1,653	Ord., U.?	Ord., L.
5	Macon	Macon Oil & Gas Co., 24-A 43e	1,600	Ord., U.	Ord., L.
6	Overton	Flaws et al., 10-1S 50e	1,837	Miss., L.	Ord., L.
7	Pickett	Shaeffer et al., 24-B 54e	1,915	Miss., M.	Ord., L.
8	Robertson	Heathcote et al., 8-B 31e	831	Miss., M.	Ord., U.
9	Robertson	Hawks et al., 25-B 35e	±730	Miss., L.	Ord., U.
10	Scott	Midland Corp., 1-4S 60e	2,121	Penn., L.	Miss., L.?
11	Scott	Diversa Producing Co. 8-A 59e	1,053	Penn., L.	Miss., M.
12	Scott	Diversa Producing Co., 24-B 61e	1,486	Penn., L.	Miss., M.
13	Sumner	Hawks et al., 9-A 37e	445	Miss., L.	Ord.,U.
14	Sumner	Fred Rowe, 15-B 40e	240	Miss., L.	Sil., L.
15	Sumner	Oglesby & Duncan, 9-B 38e	465	Miss., L.	Sil., M.?
16	Sumner	Britt et al., 13-B 37e	1,157	Miss., L.	Ord., M.
17	Sumner	Obermeyer et al., 13-B 39e	385	Miss., L.	Sil., L.

BY H. C. MILHOUS
Senior Geologist
Tennessee Division of Geology

production. For that reason they contribute little new information.

The sudden increase in interest in Tennessee is an outgrowth of the successful production from the Laurel limestone in Green County, Kentucky, but a few tests have since been drilled in the northern and northwestern Highland Rim area of central Tennessee where conditions similar to those in Green County may be expected to exist. Large blocks of acreage have been leased in that area, however, and many tests are expected to be drilled during the current year.

The outstanding test well of last year was 1 American Association which was drilled in Claiborne County in the Pine Mountain overthrust block. This well was completed as an oil producer in the Warsaw at 2,992-3,016 ft. and was producing about 4 bbl. per day when it was abandoned a few months later. While production was disappointing, this hole extends many miles eastward an old producing horizon which has not been adequately tested even in Morgan County, where it has produced for many years.

A gas well, the Diversa Producing Co. 1 Davis, was completed in Morgan County in December but was still shut in at the end of the year pending arrangements for sale of the gas. Tests had been run and potential was estimated at 2-3 M.M.c.f.d. The pay was reported to be in the Gasper-Ste. Genevieve at 1,162 ft.

A small oil well was completed in Clay County in the old Peterman Bend Pool and another in the Mill Creek Pool of the same county. In Jackson County another small well

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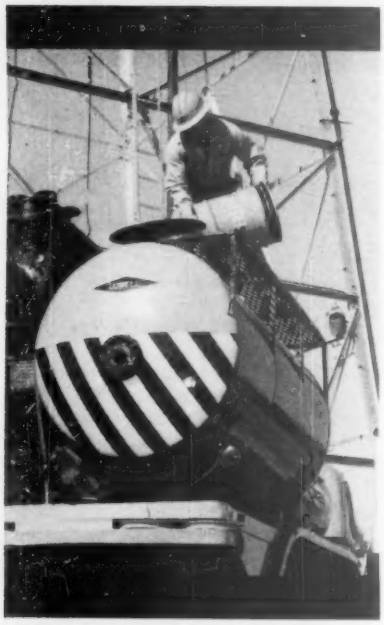
WATER BLOCK?



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was completed in the Tinsley's Bottom Pool. These pools were discovered in the 1920's and had not produced for several years. Production is from rocks of the Stones River group.

No drilling was reported in West Tennessee, nor east of the Cumberland Plateau in East Tennessee. The pattern of leasing suggests that most of the drilling this year will again be concentrated between the Tennessee River and the Cumberland Escarpment. Interest has been expressed in the West Tennessee province and some drilling is expected to take place there before long.

An accurate count of the number of acres under lease is impractical, but the number is believed to have doubled or tripled since early 1959. This means that 1-1½ million acres are under lease in the state, and if only a small part of this is tested, it will result in many interesting wildcats.

This revival of interest in a sparsely drilled wildcat area has brought in operators from many parts of the country, and their different methods of drilling and completion will provide much-needed experimentation to find the best methods for testing the possibilities. This year is expected to be one of the most active in the history of exploration in Tennessee.

Gas Production

Gas production from the wells of Scott and Morgan counties is reported at 52,450 M.c.f. for 1959. Production from Jamestown field in Fentress County is again estimated at 6 M.M.c.f., and production from privately owned wells is estimated at 5 M.M.c.f.

Oil Production

Total oil production for the year was 9,300 bbl. Following is a breakdown by counties: Claiborne, 497 bbl.; Clay, 618 bbl.; Jackson, 352 bbl.; Morgan and Scott, 7,156 bbl.; Pickett, 617 bbl.; and Robertson, 60 bbl.

Acknowledgment

The writer expresses his thanks for the assistance of W. D. Hardeman, state geologist of Tennessee, and for the cooperation of the drillers, operators, and refiners who furnished valuable information.

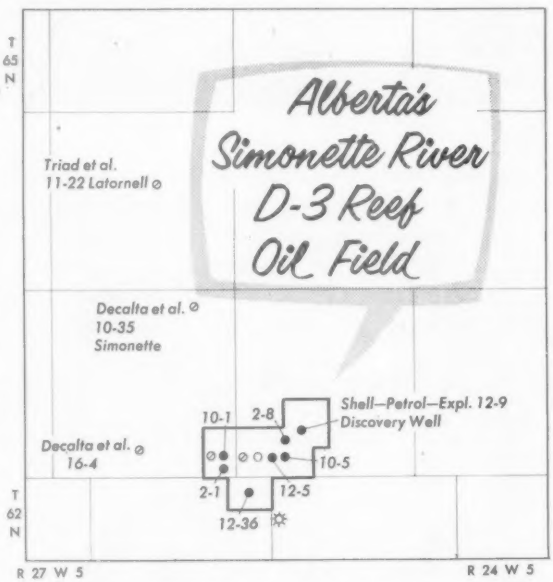
Strike stretches Ohio's Marion play southeast

In Ohio, Lucky Strike Drilling Co. moved about 1 mile southeast from the oil play in Marion Township, and completed 1 Chas. Nonemaker, Section 36, Green Township, Hocking County. Clinton sand was logged at 2,646-82 ft. and made 80 bbl. of oil with an estimated 500 M.c.f. of gas in a 24-hour test 10 days after fracture.

Also in Hocking County, Savage & Williams found Berea production in an offset to an abandoned gasser completed in 1924. The 2 Hazel M. Turner, Section 28, Benton Township, made 40-bbl. of oil per day after shot from the sand at 809-821 ft.

Tests continue in Canadian field

EVALUATION of western Alberta's big D3 reef at Simonette River continues. Shell Oil Co. of Canada, Ltd., opened the field in 1958 at 12-9 Simonette River. This well was followed by six other successes in the field, five dry holes, and one Devonian D1 gas discovery. Current work includes two wells drilling, and location staked for one more try. Western Decalta Petroleum, Ltd., is drilling at 16-4 Simonette River, west of the field proper, and are coring in the reef. Northwest of the field 5 miles Decalta is drilling at 10-35 Simonette. The Triad wildcat at Latornell is expected to go only to 7,400 ft. The reef at Simonette River is between 11,000 and 12,000 ft.



B.C. bags third oil pool of 1960

ONE OF THE latest oil discoveries in British Columbia appears to be very significant. Drilled in the Blueberry gas region about 60 miles northwest of Fort St. John, the well flowed oil to surface during a drill-stem test that was run over a 5-minute period. Due to the shortness of the test it was impossible to measure flow rate but no water was recovered when pipe was pulled indicating that the water line had not been penetrated at least 18 ft. below the formation's contact point. Coring operations are presently under way on the hole and if warranted, another test will undoubtedly be run to fully evaluate the horizon.

This strike, Sun et al. d-97-D Blueberry, is being drilled on Quarter Unit D, Unit 97, Block D, National Topographic Series Index Map 94-A-13. It is 13 miles northwest of the Sun et al. a-22-B Blueberry, that found small traces of oil in the same formation from which the new well has indicated production, 1 mile northwest of a pair of natural-gas successes and 9 miles south of the Union b-42-L Aitken Creek Gething zone oil discovery well.

The new discovery found its oil in the Nikinassin horizon near the 4,200-ft. level. A 30-ft. interval straddling the top of the horizon was evaluated through drill-stem test and in addition to flowing oil, also gave a ntaural-gas flow measured at maximum 638 M.c.f.d. Pipe recovery consisted of 540 ft. of gassy oil. The tester, as was stated before, was only open 5 minutes but gas surfaced in 1 minute and oil in 4 minutes.

This venture is being operated by Sun Oil Co. with Fargo Oils, Ltd., General American Oils, Ltd., and Western Natural Gas Co. participating.

The new strike increases to three the number of commercial oil finds reported so far this year and to four the number that has been uncovered this drilling season. In addition to those, however, are a number of wells that are rumored oil strikes, major stepout successes and important extension producers. Information on those latter tests is being withheld by operators due to a recent land sale in the province and other available Crown Reserve in close proximity.

Due to the fact that a pipeline into the northeastern sector of British Columbia is to be started very soon, more and more operators will be taking a good hard look at the oil situation in the province. Actually that transition has already started and can be borne out by the results of a recently held land sale that netted the government almost $2.2 millions. A substantial part of the lands included in the sale were considered to be oil tracts and of the 18 parcels sold 14 were in that category. Those 14 brought in $1.3 million with individual bids ranging from $15 per acre for wildcat parcels up to $648.93 per acre for proven tracts.

Discovery wells

ARKANSAS

Franklin County:

Stephens, Inc., 1 U. S. Government Unit, 16-11n-26w, IP 250 M.c.f.d., shut-in pressure 409 psi., perf. 1,242-58 ft., Upper Atoka, and 1,050 M.c.f.d., TP 520 psi., perf. 1,510-35 ft. and 1,706-14 ft., Lower Atoka. TD 1,884 ft. New pay (Upper Atoka) in Rock Creek (Barnes) field.

Union County:

Richard V. Jobst 1 Olin Oil & Gas Corp., 34-17s-14w, 1¼ miles southeast of Nick Springs. IPP 10 BOPD, 17.5°, perf. 3,080-84½ ft., Tuscaloosa. TD 3,087 ft. Extends East Nick Springs field.

WESTERN CANADA

Alberta:

Amerada 6-10 Crown, LSD 6, 10-42-7w5. Cardium oil discovery. TD 6,538 ft.

Pan American E-36 Lobstick, LSD 10, 15-50-8w5. Cardium oil discovery. TD 6,470 ft.

Pan American D-1 Cynthia, LSD 10, 30-50-9w5. Cardium oil discovery. TD 4,960 ft.

Cal-Standard-Shell 16-6 Moose Mountain, LSD 16, 6-23-6w5. Mississippian gas discovery. TD 14,010 ft.

British Columbia:

Sinclair et al. B17K Dog Rib, B-17-K-94-C-1. Baldonnel gas discovery. TD 5,306 ft.

Domestic Foreign

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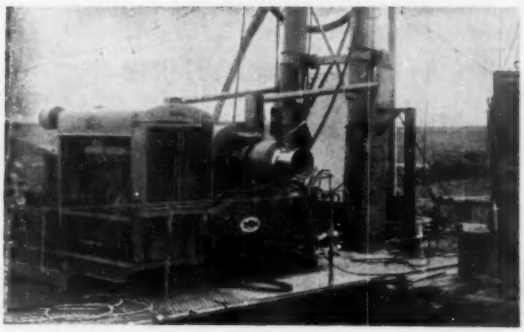

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February completion roundup 1960

TOTAL COMPLETIONS

	Total	Crude	Cond.	Gas	Dry	Service	Footage
Alabama	3	2	0	0	1	0	25,618
Arkansas	56	29	0	3	24	0	194,410
California	72	44	0	3	20	5	350,372
Colorado	54	11	0	7	36	0	250,972
Florida	1	0	0	0	1	0	12,076
Illinois	223	76	0	0	104	43	405,936
Indiana	68	22	0	1	45	0	91,762
Iowa	1	0	0	0	1	0	507
Kansas	264	125	1	16	117	5	968,679
Kentucky	145	48	0	42	49	6	267,759
Louisiana	214	87	17	23	84	3	1,661,058
North	68	23	0	17	28	0	269,212
South	112	51	15	4	40	2	1,033,383
Offshore	34	13	2	2	16	1	358,463
Michigan	72	35	0	1	34	2	255,568
Mississippi	54	27	4	0	23	0	535,641
Missouri	2	1	0	0	1	0	6,714
Montana	12	7	0	0	5	0	47,753
Nebraska	49	17	0	0	32	0	279,682
New Mexico	138	84	5	20	29	0	673,965
West	44	17	4	18	5	0	198,056
East	94	67	1	2	24	0	475,909
New York	25	13	0	1	4	7	40,638
North Dakota	24	18	0	0	6	0	149,995
Ohio	83	32	0	20	31	0	219,206
Oklahoma	288	138	2	36	104	8	1,328,775
South Dakota	2	2	0	0	0	0	17,337
Tennessee	8	0	0	0	8	0	7,300
Texas	1,036	529	42	47	385	33	4,391,035
District 1	76	32	1	2	39	2	218,667
District 2	44	9	5	14	16	0	282,889
District 3	75	28	7	1	38	1	546,705
District 4	69	12	13	6	38	0	405,817
East	75	41	6	0	25	3	330,784
District 7-B	166	74	0	6	85	1	494,708
West	230	168	5	1	55	1	1,165,615
District 9	204	105	3	5	71	20	522,142
District 10	97	60	2	12	18	5	418,708
Utah	18	12	0	3	3	0	95,669
West Virginia	79	3	0	67	9	0	183,216
Wyoming	71	31	0	3	35	2	314,157
Total Feb. 1960	**3,062**	**1,393**	**71**	**293**	**1,191**	**114**	**12,775,800**
Total Jan. 1960	4,223	1,971	161	347	1,610	134	18,362,643
Cumulative 1960	**7,285**	**3,364**	**232**	**640**	**2,801**	**248**	**31,138,443**
Cumulative 1959	8,144	4,075	205	579	3,073	212	34,364,187

WILDCAT WELLS

	Total	Crude	Cond.	Gas	Dry	Footage	C.T.	D.D.	Act. op.
Alabama	1	0	0	0	1	2,646	0	0	5
Arkansas	15	2	0	1	12	57,686	0	0	73
California	16	1	0	1	14	103,879	1	0	80
Colorado	26	2	0	2	22	123,852	0	0	80
Florida	1	0	0	0	1	12,076	0	0	1
Illinois	59	4	0	0	55	91,463	41	0	363
Indiana	30	2	0	0	28	35,381	39	0	114
Iowa	1	0	0	0	1	507	1	0	1
Kansas	83	17	0	5	61	314,652	30	0	344
Kentucky	19	1	0	0	18	27,435	91	0	168
Louisiana	28	2	1	2	23	260,846	0	0	367
North	11	0	0	2	9	60,980	0	0	104
South	13	2	1	0	10	152,493	0	0	219
Offshore	4	0	0	0	4	47,373	0	0	44
Michigan	17	2	0	0	15	59,802	54	0	147
Mississippi	23	4	0	0	19	213,606	0	0	64
Missouri	2	1	0	0	1	6,714	0	0	1
Montana	6	3	0	0	3	26,323	2	0	40
Nebraska	21	5	0	0	16	113,171	0	0	64
New Mexico	15	1	0	0	14	64,521	42	4	159
West	3	1	0	0	2	15,944	14	4	68
East	12	0	0	0	12	48,577	28	0	91
New York	3	0	0	1	2	10,938	25	0	10
North Dakota	3	0	0	0	3	11,069	0	0	33
Ohio	8	0	0	2	6	26,215	83	0	191
Oklahoma	49	12	0	4	33	289,619	46	7	663
South Dakota	0	0	0	0	0	0	0	0	7
Tennessee	8	0	0	0	8	7,300	8	0	21
Texas	204	10	2	4	188	1,003,284	69	26	986
District 1	30	0	0	0	30	79,625	0	0	33
District 2	11	0	0	1	10	70,134	0	1	57
District 3	18	0	1	0	17	154,736	0	0	65
District 4	24	2	1	1	20	152,597	5	2	69
East	10	1	0	0	9	57,443	0	0	41
District 7-B	45	2	0	2	41	135,149	0	0	88
West	36	3	0	0	33	190,512	19	20	409
District 9	23	1	0	0	22	96,156	45	3	101
District 10	7	1	0	0	6	66,932	0	0	123
Utah	5	1	0	2	2	26,494	0	2	48
West Virginia	0	0	0	0	0	0	79	0	189
Wyoming	23	4	0	1	18	100,527	3	2	152
Total Feb. 1960	**666**	**74**	**3**	**25**	**564**	**2,990,006**	**614**	**41**	**4,371**
Total Jan. 1960	951	78	12	27	834	4,356,022	681	30	4,544
Cumulative 1960	**1,617**	**152**	**15**	**52**	**1,398**	**7,346,028**	**1,295**	**71**	...
Cumulative 1959	1,605	172	20	58	1,355	8,040,671	...	...	...

Note: C.T.=Cable-tool comp. D.D.=Drilled deeper. Act. op.=Active operations.

. . . and in Canada

	Total	Oil	Gas	Dry	Footage	Cum. 1960	Total	Oil	Gas	Dry	Footage	Cum. 1960
Alberta	149	91	16	42	952,742	318	38	5	2	31	229,248	84
Saskatchewan	41	24	0	17	176,192	85	10	0	0	10	45,522	24
Manitoba	8	4	0	4	16,963	15	3	0	0	3	6,817	5
British Columbia	26	10	5	11	126,641	38	14	2	4	8	71,874	18
Northwest Territories	2	0	0	2	4,381	2	2	0	0	2	4,381	2
Western Canada	**226**	**129**	**21**	**76**	**1,276,919**	**458**	**67**	**7**	**6**	**54**	**357,842**	**133**
Ontario	30	3	10	*17	39,079	46	...	...	...	...	...	...

*Inclusive of service.

Phillips D 80-E, 80-E-94-A-16. Triassic oil discovery. TD 3,860 ft.

Pacific B-44-C North Kotcho, 44-C-94-P-3. Slave Point gas discovery. TD 6,835 ft.

Gulf States D-39-J Kotcho Lake, 39-J-94-I-14. Slave Point gas discovery. TD 8,413 ft.

Saskatchewan:

Texas 12-10 Wood Mountain, LSD 12, 10-5-8w3. Inert gas well. TD 8,675 ft.

ILLINOIS

Clay County:

March Drilling Co. 1 Mae Kincaid, NW SW NE 4-3n-6e. IP 35 BOPD, 80 BWPD, O'Mara 2,893-95 ft. TD 3,048 ft. South Louisville discovery.

Coles County:

Development Associates Inc. 1 W. H. Tracy, NE NW NE 27-13n-17e. IP 145 BOPD, Rosiclare 1,902-12 ft. TD 1,920 ft. Opens North Mattoon field.

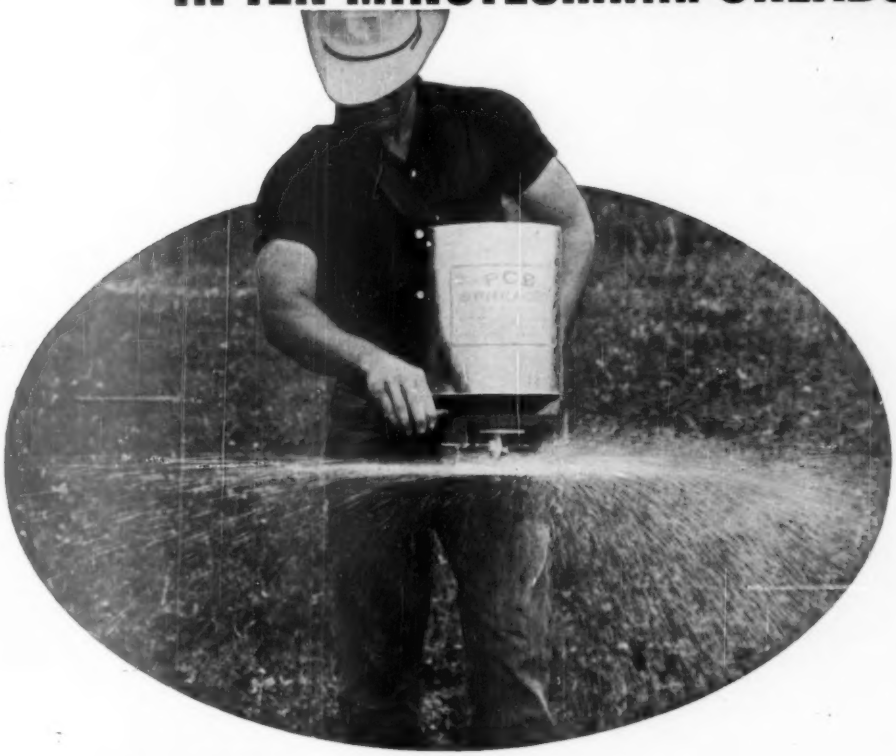
Jefferson County:

J. F. Dunnill 1 Barnett, SW SE NE 18-1s-4e. IP 168 BOPD, McClosky 2,820-24 ft., St. Louis 2,847-52, 2,858-62 ft. TD 2,937 ft. New pay discovery.

Sangamon County:

Alladin Oil Co. 1 Scott, SE NW SW 21-15n-4w. IP 528 BOPD, Silurian 1,557-1,605 ft. TD 1,605 ft. Opens East Springfield field.

ANY MAN CAN WEED-PROOF 10,000 SQUARE FEET IN TEN MINUTES...with UREABOR



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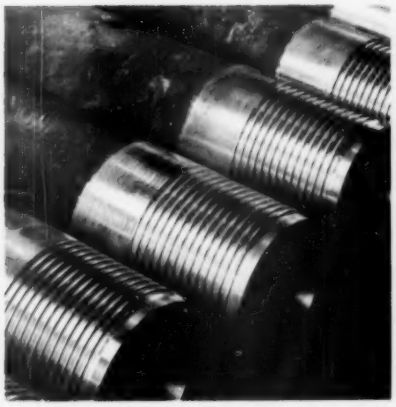
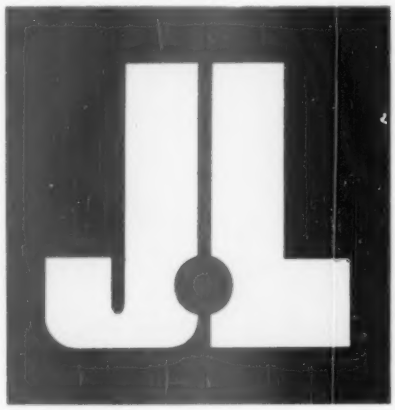
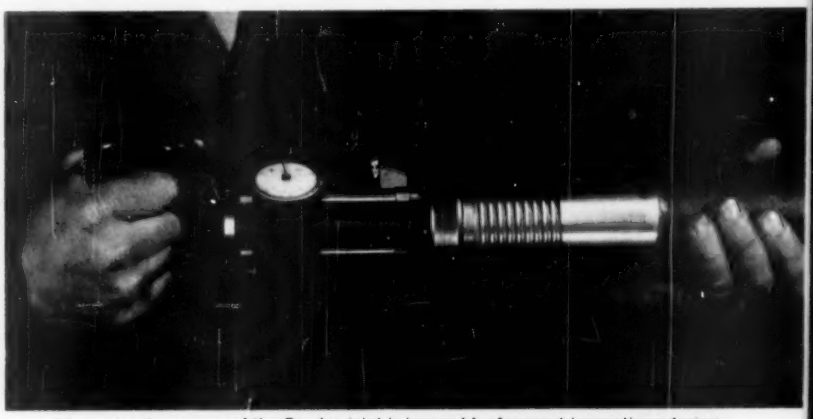
Independent sealing ring in each Grayloc joint provides primary sealing force.



Modified Acme-type threads provide easy stabbing, fast make-up, high resistance to damage.

Grayloc joint is machined on special facilities at J&L's Aliquippa (Pa.) Works.





Dimensional accuracy of the Grayloc joint is insured by frequent inspections during machining operations. It is available in grades J-55, N-80 and P-105.

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. . . reports Texas driller

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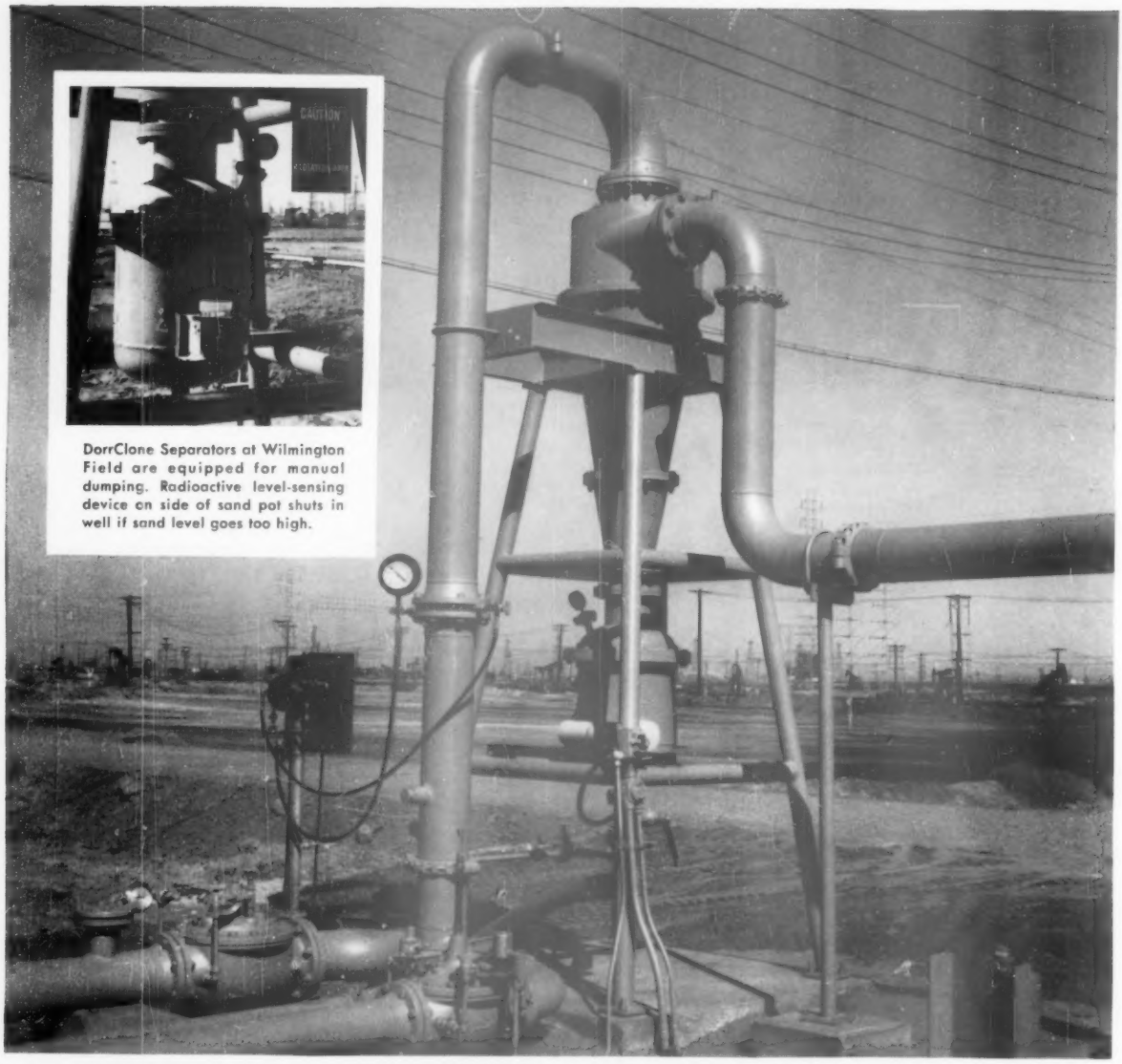
Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA



DorrClone Separators at Wilmington Field are equipped for manual dumping. Radioactive level-sensing device on side of sand pot shuts in well if sand level goes too high.

15 DORRCLONE SEPARATORS PROTECT PUMPING PLANTS FROM SAND IN WORLD'S LARGEST FLOODING OPERATION

■ California's Wilmington Field water flood operation, built and owned by the Long Beach Harbor Department, is being systematically carried out, fault block by fault block. Purpose is to increase oil recoveries, and to check land subsidence in the field.

At the heart of the system are completely automatic plants which take oxygen-free brine from nearby source wells, desand it, treat it and pump it into the oil bearing zones at 850-1250 psig.

DorrClone separators are operating on 15 wells in the field – removing 98% of all material with a specific gravity greater than 2.6. They keep mains and pumps sand-free for continuous operation at full capacity.

Feed water enters the upper chamber of the DorrClone unit tangentially creating a vortex action. Resulting centrifugal force throws the sand particles to the rubber coated walls of the cone where they pass downward to the underflow chamber. Sand-free water moves to the inner spiral of the vortex and is displaced upward and out into the mains.

The photograph demonstrates the simplicity of the installation. Units can be designed to suit practically all well water systems. For full information, write, Dorr-Oliver Incorporated, Stamford, Conn.

DorrClone – T.M. Reg. U.S. Pat. Off.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

February footage account

	FIELD WELLS					WILDCAT WELLS			
	Oil	Cond.	Gas	Dry	Service	Oil	Cond.	Gas	Dry
Alabama	22,972	.....	.....	.....	.....	.....	.....	.....	2,646
Arkansas	80,374	.....	11,008	45,342	.....	6,500	.....	1,884	49,302
California	192,739	.....	9,312	20,436	24,006	9,543	.....	6,300	88,036
Colorado	37,608	.....	25,231	64,201	.....	14,349	.....	9,149	100,354
Florida	.....	.....	.....	.....	.....	.....	.....	.....	12,076
Illinois	166,722	.....	.....	94,673	53,078	8,407	.....	.....	83,056
Indiana	33,209	.....	.....	23,172	.....	1,934	.....	.....	33,447
Iowa	.....	.....	.....	.....	.....	.....	.....	.....	507
Kansas	363,972	5,402	53,317	212,996	18,340	69,493	.....	18,772	226,387
Kentucky	49,989	.....	135,851	46,673	7,811	3,200	.....	.....	24,235
Louisiana	646,044	185,834	90,302	468,730	9,302	21,851	11,638	16,683	210,674
North	67,789	.....	37,226	103,217	.....	.....	.....	16,683	44,297
South	445,847	159,534	27,601	242,171	5,737	21,851	11,638	.....	119,004
Offshore	132,408	26,300	25,475	123,342	3,565	.....	.....	.....	47,373
Michigan	117,584	.....	4,050	65,385	8,747	8,417	.....	.....	51,385
Mississippi	243,060	39,725	.....	39,250	.....	23,699	.....	.....	189,907
Missouri	.....	.....	.....	.....	.....	3,124	.....	.....	3,590
Montana	19,030	.....	.....	2,400	.....	19,932	.....	.....	6,391
Nebraska	73,408	.....	.....	93,103	.....	25,446	.....	.....	87,725
New Mexico	393,259	40,811	96,990	78,394	.....	1,958	.....	.....	62,563
West	52,206	26,164	93,522	10,220	.....	1,958	.....	.....	13,986
East	341,053	14,647	3,468	68,164	.....	.....	.....	.....	48,577
New York	17,550	.....	.....	2,150	10,000	.....	.....	5,252	5,686
North Dakota	125,803	.....	.....	13,123	.....	.....	.....	.....	11,069
Ohio	7,416	.....	54,240	61,335	.....	.....	.....	3,496	22,719
Oklahoma	538,730	16,531	214,252	250,679	18,964	78,523	.....	30,977	180,119
South Dakota	17,337	.....	.....	.....	.....	.....	.....	.....	.....
Tennessee	.....	.....	.....	.....	.....	.....	.....	.....	7,300
Texas	1,946,483	345,131	199,081	824,050	73,006	63,048	19,041	22,595	898,600
Dist. 1	72,568	11,200	20,770	29,461	5,043	.....	.....	.....	79,625
Dist. 2	68,580	42,110	66,171	35,894	.....	.....	.....	5,200	64,934
Dist. 3	128,049	68,550	9,910	177,101	8,359	.....	11,026	.....	143,710
Dist. 4	42,734	100,924	15,734	93,828	.....	8,911	8,015	8,424	127,247
East	161,986	47,805	.....	62,209	1,341	4,558	.....	.....	52,885
Dist. 7-B	217,749	.....	14,668	130,639	1,503	10,045	.....	8,971	116,133
West	807,808	42,692	2,607	121,896	100	24,849	.....	.....	165,663
Dist. 9	213,288	18,225	27,819	123,235	43,419	6,205	.....	.....	89,951
Dist. 10	233,721	13,625	41,402	49,787	13,241	8,480	.....	.....	58,452
Utah	62,848	.....	6,292	35	.....	3,031	.....	16,190	7,273
West Virginia	4,907	.....	160,945	17,364	.....	.....	.....	.....	.....
Wyoming	142,167	.....	14,370	47,677	9,416	16,286	.....	4,375	79,866
Total U. S.	**5,373,291**	**633,434**	**1,075,241**	**2,471,158**	**232,670**	**378,741**	**30,679**	**135,673**	**2,444,913**
Western Canada	705,338	.....	98,576	115,163	.....	38,431	.....	42,668	276,743
Alberta	561,605	.....	94,328	67,561	.....	30,826	.....	20,101	178,321
Saskatchewan	100,700	.....	.....	29,970	.....	.....	.....	.....	45,522
Manitoba	8,016	.....	.....	2,130	.....	.....	.....	.....	6,817
British Columbia	35,017	.....	4,248	15,502	.....	7,605	.....	22,567	41,702
Northwest Territories	.....	.....	.....	.....	.....	.....	.....	.....	4,380

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VALVES

Douma Leads Sunray Switch

. . . to Denver from Los Angeles in consolidation of firm's exploration and production program in the West.

JOHN DOUMA swears that being born in the town of Oilfields, Calif., had absolutely nothing to do with his choice of the oil industry as a career.

"In fact, I didn't decide to study petroleum engineering until I had worked as a roustabout during a summer vacation," says Douma, vice president and manager of Sunray Mid-Continent's new western division at Denver.

He worked on his father's farm after graduating from high school and decided farming wasn't for him. And even though he'd lived around the California oil fields all his life, Douma never considered the oil business as a career until that roustabouting summer when a field superintendent began to make an impression on him.

John Douma
. . . a key man for Sunray.

New step . . . Today, John Douma is a key figure in Sunray Mid-Continent's decentralization program.

He recently was named manager of a new western division which consists of consolidated Rocky Mountain and West Coast divisions. He'll take over the new helm in Denver about June 1.

"This consolidation is a natural," Douma says. "We'll have a well balanced exploration and production program in an area that shows great potential."

The geographic area of the new division, the largest in the company, stretches from the Four Corners area of New Mexico to California, from North Dakota to Washington.

Just last summer Douma was named vice president and manager of the company's long established California operations. At that time, the name was changed to West Coast division. The company's entire production, exploration, and marketing organizations were decentralized in midyear.

Although the consolidation of two divisions seems to be a centralizing move instead of decentralizing, Douma is quick to point out that Sunray Mid-Continent isn't playing follow-the-leader or decentralizing just for decentralizing's sake.

"Each company has a different organizational structure and its management must constantly be searching for advantageous realignments and shifts to get the maximum output," he says.

"This consolidation proves the point. No company should remain static; the door should always be open to reorganization possibilities that will boost ultimate efficiency."

Man for the spot . . . Douma is a logical choice to head up the new Western division.

You could call him the production man's production man. He has a solid background of experience in both Mid-Continent and West Coast production.

Following his graduation in petroleum engineering from the University of California at Berkeley in 1938, he joined the former Barnsdall Oil Co. as a field engineer in California.

Some 4 years later he was transferred to the Tulsa headquarters as staff engineer. At the time of the Barnsdall-Sunray merger in 1950, he was general production superintendent. Before returning to California as a division manager he held two key positions, manager of engineering and manager of joint operations.

In a way, Douma regrets leaving his native California. The climate is conducive to his one and only hobby—golf. He's modest about his 10 handicap but he beams about his son Bobby's handicap of 5. Bobby is a junior at San Marino high school where he's a mainstay on the golf team. Douma has a daughter, Sharon, who is a sophomore at UCLA this year.

In Los Angeles, Douma is a member of the Petroleum Club, Jonathon Club, API, Society of Petroleum Engineers of AIME, and is a director of Oil Producers' Agency of California and Western Oil and Gas Association.

From his record, it's apparent that Douma has proved himself quickly in each new position. Sunray's management evidently took that into consideration when they chose him to head up the new 14-state organization.

▶▶▶ Personals

J. W. Cole, Jr., has been elected vice president of West Texas Gathering Co. and will continue as general manager and assistant manager of the company. Cole had been with Sinclair Oil & Gas Co. and Gulf Oil Corp. before joining West Texas Gathering in 1958.

Frank A. Leisey has been named senior project supervisor in the Whiting, Ind., research laboratories of Standard Oil Co. (Ind.). Leisey has been with Indiana Standard since 1947.

Charles T. Abercrombie, petroleum engineer with Cities Service Oil Co., has been transferred to Brownfield, Tex., from Wichita Falls, Tex.

E. K. Dewey, Jr., mechanical superintendent of Continental Oil Co.'s Lake Charles, La., refinery, has been promoted to general maintenance engineer in the headquarters manufacturing department, Ponca City, Okla. Dewey has been with Conoco since 1937. **Roger M. Haynes,** mechanical superintendent at the Billings, Mont., refinery, will succeed Dewey in Lake Charles. Haynes joined Conoco in 1949.

Ernest L. Jacobsen, Jr., has been named acting assistant director of Esso Research & Engineering Co.'s construction engineering division. Jacobsen formerly was on special assignment. **Frank H. Yurasko,** an assistant director in the construction engineering division, has been named a project manager in engineering coordination.

Robert L. Topper, executive assistant to the president of Transcontinental Gas Pipe Line Corp., has been named president of Trans-Jeff Chemical Corp., Houston, new company formed by Transcontinental and Jefferson Lake Sulphur Co. The new firm

will build a sulfur-recovery plant in McMullen County, Texas, as its first venture. Other officers of Trans-Jeff are **Francis E. Lewis** and **Bradlee V. B. Postell,** vice presidents; **William H. Davidson, Jr.,** secretary; **A. E. Bryan,** treasurer; and **A. D. Kirby,** assistant secretary and assistant treasurer. Directors include Topper, Lewis, **Eugene H. Walet, Jr., James B. Henderson, J. F. Burton, Harvey A. Wilson,** and **Herbert M. Seydler.** Officers and directors, except for Seydler, are with Transco or Jefferson Lake. Seydler is a senior vice president of the Bank of the Southwest.

E. W. McNealy, general superintendent of the Port Arthur, Tex., refinery of Texaco Inc., has been promoted to works manager in Port Arthur. He succeeds **Henry Flynn,** who recently was named general manager of Texaco's domestic refining department. **Jack C. Williams,** supervisor of the refini _ department's process and

McNEALY

WILLIAMS

production division in New York, will succeed McNealy as general superintendent in Port Arthur. McNealy has been with Texaco since 1932. He was superintendent of the Westville, N. J., and Lockport, Ill., refineries before moving to Port Arthur in 1957 as assistant general superintendent. Williams joined Texaco in 1941. He is a former assistant superintendent of operations at Texaco's San Antonio, Tex., West Tulsa, and Lockport, Ill., refineries. He had held the New York post since 1955.

Roland L. Wentworth has been elected a director of Plymouth Oil Co. and named Plymouth vice president in charge of refining and marketing of the Republic Oil Refining division. Wentworth has been with Republic since 1954.

H. E. Lumpkin has been promoted to senior research chemist in Humble Oil & Refining Co.'s research and development division, Baytown, Tex. **H. E. von Rosenberg** has been named senior research chemical engineer. Lumpkin will specialize in analytical research in mass spectrometry; von Rosenberg will work with catalytic cracking research.

Dr. James R. Dudley, vice president of Richardson Co., will take office July 1 as president of Commercial Chemical Development Association. New officers elected at a recent New York meeting include **Dr. James G. Affleck,** manager of the rubber chemicals department in American Cyanamid Co.'s organic chemicals division, president-elect; **Winthrop M. Barnes,** Sun Oil Co., executive secretary; **Dr. Alfred G. Rossow,** Mobil Oil Co., treasurer. New directors are **Dr. Robert I. Stirton,** Oronite Chemical Co.; and **Harry F. Pfann,** Pittsburgh Coke & Chemical Co.

Dr. Calvin N. Wolf, formerly manager of research in Petro-Tex Chemical Corp.'s Princeton, N. J., laboratories, has organized Princeton Chemical Research, Inc., new contract research and development company. Headquarters will be in Princeton. Wolf was with Ethyl Corp. before joining Petro-Tex.

Paavo Puumala, formerly with Mobil Oil Co. in Roswell, N. M., has been transferred to Mobil Oil Co. of Canada as chief geologist. **Peter Fleming,** production superintendent in Calgary, has been appointed chief engineer for Mobil of Canada. In other changes, **Dick Slavin,** Calgary, has been named district exploration superintendent in Dawson Creek, B. C. **Bill Work,** Calgary, has been named district exploration superintendent there. **Ken Coulter,** Edmonton, will be Edmonton district exploration superintendent. **Lou Castelli,** Calgary, has been appointed Regina district exploration superintendent. New district production superintendents are **Dick Hebberd,** in Drayton Valley, Alta.; **Ed Barroll,** in Edmonton; and **Fred Bird,** in Regina. Barroll and Bird were formerly in Calgary. Hebberd's headquarters have been in Drayton Valley. Also, **Don Axford,** Calgary, has been transferred to Mobil Oil Co. as Midland, Tex., division geologist.

Harrison F. Murray, senior geologist for Monsanto Chemical Co.'s Lion Oil Division in Denver, has been appointed chief staff geologist in the production and exploration department, a new position. He will headquarter in Houston. Murray was a consulting geologist in Denver before joining Lion Oil in 1957.

E. Allan Morrow, vice president of Leonard Refineries, Inc., has been named a member of the Michigan State Oil Advisory Board. He succeeds **I. W. Hartman,** independent operator, who has moved to Florida. Morrow is a former president of the Oil and Gas Association of Michigan.

▶▶▶ Personals

George S. Dunham, executive vice president, Far East, for Mobil International Oil Co., will take over responsibility for Socony Mobil Oil Co.'s marine transportation, supply and distribution, and purchasing departments. He succeeds **Clark S. Teitsworth,** who will retire May 17 as a director and senior vice president of Socony Mobil. Dunham will be proposed for election as a senior vice president on May 17. He is already a director of Socony. **Frank S. Cooper, Jr.,** an executive vice president of Mobil International, will succeed Dunham as executive vice president, Far East. Dunham joined a Socony Mobil affiliate in 1925. He has been a director of Socony since 1953 and an executive vice president of Mobil International since last year. Cooper has been with the company since 1945. Teitsworth is retiring after 34 years with the company. He was elected a director in 1947 and was named director and vice president in charge of supply and distribution in 1953. He became a senior vice president last year.

DUNHAM

Dr. H. C. Huffman, supervisor of product research at Union Oil Co.'s Brea, Calif., research center, has been promoted to manager of the refining research division. He will be responsible for process and product research as well as analytical services. Huffman succeeds **Dr. W. E. Bradley,** who recently was named director of research for the company. **Dr. James B. Gregory** will succeed Huffman. Also at Brea, **William J. Baral** has been promoted to commercial development representative.

John C. Denton, president of Spencer Chemical Co., has been named chief executive officer. **C. Y. Thomas,** vice chairman of the board, has been elected chairman. They succeed the late Kenneth A. Spencer, chairman and chief executive officer. **Ralph L. Gray,** chairman of Armco Steel Corp., has been elected a director of the company.

A. F. Beale, Jr., director of chemical research for Dow Chemical Co.'s Dowell Division, has been appointed director of research for Dowell Division. He succeeds **Dr. W. W. Love,** who has been named research consultant.

Personals

Jack P. Robbins, Skinner Corp., has been elected chairman of American Petroleum Institute's southern district. He succeeds **A. L. Vitter, Jr.,** The California Co. Vitter has been named chairman of the district advisory committee. **Paul Clinkonbeard,** Dow Chemical Co.'s Dowell Division, has been named district secretary-treasurer. New vice chairman are **Walter Kalteyer,** Hunt Drilling Co., vice chairman for southwest Texas; **Marvin Rogers,** Allen & Morris Drilling Co., Balcones area; **J. E. Edison,** Sun Oil Co., Rio Grande valley; **B. O. Ellington,** Baker Oil Tools, Inc., Texas Gulf Coast; **W. L. Massey,** Aluminum Corp. of America, south central Texas; **R. P. Smith,** Sun Oil, East Texas; **Raymond Perry,** Union Producing Co., Arkansas-Louisiana-Texas area; **C. R. Claus,** Circle Drilling Co., southwest Louisiana, **Russell Shirley,** Mobil Oil Co., southern Louisiana; and **S. R. Coleman,** Union Producing Co., Mississippi.

ROBBINS

Dr. George Constabaris and **Manfred J. R. Cantow** have joined California Research Corp.'s Richmond, Calif., laboratory as research chemists. New research engineers at Richmond include **William L. Bedford, Werner H. Schurter,** and **Hans L. Steinmetz. Barbara Bernstein** will be research statistician, Richmond. **Ronald N. Beamer** has joined Cal Research as research engineer at the La Habra, Calif., laboratory.

Robert E. Reinker, manager of Dow Chemical Co.'s Peverly, Mo., plastic foam plant, has been appointed assistant to the operations vice president of Dow Chemical International, Ltd., S.A. He will direct production of polystyrene plastic at plants Dow plans to build in Italy and Greece, in addition to handling administrative duties. **Raymond Duddleston,** section supervisor in process engineering for Dow's Midland, Mich., division, has been named project enginer to handle construction of the Italian plant and will be consultant in engineering and construction for the Greek plant.

Dr. George P. Speranza has been appointed supervisor of the exploratory research section in Jefferson Chemical Co.'s Austin, Tex., laboratories.

David L. Eynon, Jr., has been elected chairman, and **John A. Scott** has been named president of the new Sinclair-Koppers Chemical Co. The company is jointly owned by Sinclair Oil Corp. and Koppers Co., Inc. Other officers are **C. W. Hardell** and **Carl H. Pottenger,** vice presidents; **John M. Crimmins,** secretary; Hardell, **T. C. Cochran,** and **J. Von Bevern,** assistant secretaries; **J. P. Downer,** treasurer; **R. H. Hein** and **K. C. King,** assistant treasurers and assistant secretaries. Named to the board by Sinclair are Scott, **R. E. Howe,** and **E. J. Anglin.** Directors named by Koppers are Eynon, **Walter P. Arnold,** and **James M. Veeder.**

Ralph A. Cardello, section head in refinery project planning for Esso Research & Engineering Co., has been transferred to Florham Park, N. J., from Linden, N. J.

Seven new directors have been appointed in the consolidated research and development department of Standard Oil Co. (Ind.). In product research, **Albert W. Lindert** will direct work on new lubricants. New directors in process development are **H. D. Radford, Herman S. Seelig,** and **William L. Webb.** In commercialization of refining processes, new division directors are **John F. Snuggs,** design, and **Leonard W. Russum,** economics. **Frank G. Pearce** is a new director in chemicals research and development. Radford has headquarters in Texas City, where he is technical director of American Oil Co.'s laboratories. Others will headquarter in Indiana Standard's Whiting, Ind., research laboratories.

John W. Jordan, reservoir engineer for Sohio Petroleum Co., has been transferred to Oklahoma City from Houston.

James C. Reed, vice president, construction, for Procon, Inc., has been named executive vice president. In other changes, **Alexander G. Petkus,** vice president, engineering, has been named senior vice president for coordination, engineering, and drafting. **James R. Britt,** general manager of Procon (Great Britain), has been named vice president for Procon's European operations. **Charles B. Robbins,** assistant to the president, has been elected vice president, staff.

Robert G. Miller and **Einar B. Paust** have been named assistant general counsels of Standard Oil Co. (N.J.). Miller has been with Jersey since 1948. Paust joined Esso Standard division of Humble Oil & Refining Co. in 1946.

Homer J. Stimson, petroleum engineer with Ada Oil Co., Houston, has been promoted to production superintendent in charge of Gulf Coast operations.

Robert W. Harris, formerly on military leave-of-absence, has rejoined Humble Oil & Refining Co.'s Carter Division as engineer in Great Bend, Kans.

William J. Pettyjohn has been named manager of the new St. Louis sales district of Monsanto Chemical Co.'s Lion Oil Division. **William J. Barkley** has been named construction manager for the company's branded sales section. He will headquarter in El Dorado, Ark.

E. J. Bassett, vice president in charge of Sinclair Refining Co.'s western region in Kansas City, has been named general sales manager for the company. He will headquarter in New York. **Harry H. Young,** central region vice president, has been named western region general sales manager.

BASSETT

YOUNG

He will continue to headquarter in Chicago and will be responsible for a territory enlarged to include the central, Great Lakes, western, southwestern, and Rocky Mountain divisions. Bassett and Young are Sinclair veterans; both joined the company in 1931. The changes will realign Sinclair's marketing territory into two substantially equal regions — eastern and western. **B. P. Mackenzie** continues as general manager of the eastern division with headquarters in New York.

Roger W. Watson has been appointed section leader in the lubricants-research division at the Whiting, Ind., research laboratories of Standard Oil Co. (Ind.). **S. Paul Malchick,** has been named group leader in one of three groups in the section. **Matthew L. Kalinowski** and **Robert E. Karll** continue as other group leaders. In the automotive-research division, new group leaders are **James E. Getz, John V. Peterson,** and **Robert L. Stack.** Stack was formerly a group leader in the Texas City laboratories of American Oil Co., a subsidiary.

Charles R. Canfield, central division geologist for Pan American Petroleum Corp. in Oklahoma City, has been named regional geologist on the general office exploration staff in Tulsa, a new position. He will be in charge of wide-range regional geological investigations in North America. The new studies are part of an intensified exploration effort in North America. **Willard F. Bunker,** formerly of Jackson, Miss., will succeed Canfield in Oklahoma City. **Robert L. Nelson,** division geophysical supervisor in Oklahoma City, has been named district exploration superintendent in Jackson. **K. W. Gilbert,** district geophysicist in Lubbock, Tex., will succeed Nelson in Oklahoma City. Canfield joined Pan Am in 1941 as a geologist in Midland, Tex. He had been Oklahoma City division geologist since 1952. Bunker was district geologist in Oklahoma City before moving to Jackson in 1958.

CANFIELD

Dale F. Fink, assistant chief research chemist in Shell Oil Co.'s Wood River, Ill., laboratory, has been transferred to Shell's Emeryville, Calif., research center as a research supervisor in the bitumen department. Fink has been with Shell since 1941.

J. Porter Brinton, president of Hydrocarbon Products Co., has been elected a director of Zapata Off-Shore Co.

C. Dennis Irwin, geologist with Humble Oil & Refining Co., has been transferred to Denver from Durango, Colo. **Roger L. Billings,** geologist, has been transferred to Durango from Rawlins, Wyo.

Carl E. Wilson, district production manager in Corpus Christi, Tex., for Sunray Mid-Continent Oil Co., will retire April 1 after 41 years in the oil industry. He has been with Sunray since 1946.

George S. Leachman has been appointed district manager of Allied Chemical Corp.'s new Dallas nitrogen division sales district. Leachman was with the old Seaboard Oil Co. before joining Allied Chemical in 1958.

B. A. Vallerga has been appointed director of products engineering for Golden Bear Oil Co., Los Angeles. He will headquarter in the company's new Bakersfield, Calif., laboratory.

Thomas E. Utsman, drilling engineer with Shell Oil Co., has been transferred to Westwego, La., from New Orleans.

V. E. (Huey) Liles, formerly Houston division geologist for Shell Oil Co., has resigned to open consulting offices in Houston.

Raymond E. Poppe, senior engineer with Sohio Petroleum Co., has been transferred to Oklahoma City from Casper, Wyo.

Charles C. Salter, district production supervisor in Hobbs, N. M., for Sinclair Oil & Gas Co., has retired.

C. E. Paules, vice president of Esso Research & Engineering Co., has retired after 41 years with the company.

A. L. Hill, manager of geological and reservoir engineering for El Paso Natural Gas Co., has been named general manager of production and exploration. In other appointments, **Warren L. Taylor** has been named manager of geological and exploration operations. **A. M. Derrick** has been named manager of reservoir engineering, and **L. G. Truby, Jr.,** will be manager of production. **Samuel Smith** will continue as manager of the land department. Appointed division superintendents, geological and exploration, were **Robert N. Richey,** Salt Lake City; **D. N. Canfield,** Farmington, N. M.; **A. E. Miller, Jr.,** Amarillo, Tex.; and **Hal S. Dean,** Midland, Tex.

John Crawford, formerly Rocky Mountain division geologist for Argo Oil Corp., has opened consulting offices in Denver.

M. A. Gravender, formerly in Salt Lake City for Texas Gulf Producing Co., has been transferred to Denver as head of the company's new division office there. **Joe Mazzola,** formerly with Kingwood Oil Co. in Denver, has joined Texas Gulf Producing there as geologist.

▶▶▶ Personals

Clifford E. Pehl, executive engineer with Bechtel Corp.'s international division in San Francisco, has been elected a vice president of Bechtel International Corp.

Eugene M. Baysinger, New Orleans consulting geologist, has joined Hershey Oil Corp. as exploration manager. Baysinger was with Texaco Inc. and Monterey Oil Co. before becoming a consultant.

S. R. Knapp, tool pusher with Falcon Seaboard Drilling Co., has been transferred to Ardmore, Okla., from Lindsay, Okla.

Edwin E. Evans, vice president and secretary-treasurer of Western States Refining Co., has been named vice president, systems, for Frontier Refining Co. in Denver. Western States is a Frontier subsidiary. In other changes, **Nathan B. Hale** was named vice president and manager of Western States' Salt Lake City office. **Samuel J. Carter** has been elected a director of Western States and **Raymond Williamsen,** comptroller, has been named treasurer and comptroller.

Netum A. Steed, Taubert & Steed Drilling Co., has been elected president of the North Texas Oil and Gas Association. Other new officers are **David A. Kimbell,** Alan Drilling Co., first vice president; and **George W. Graham,** Wichita Falls, Tex., independent, second vice president. **George W. Anderson, Jr.,** will continue as executive vice president.

James T. Outz, a special assistant to the general manager of marketing in Humble Oil & Refining Co.'s Esso Standard Division, has been named head of Humble's new Ohio marketing division. Division headquarters will be in Columbus. Outz is a former assistant New York division manager for Esso.

▶▶▶ Deaths

Harry A. Dempsey, pioneer Appalachian area oil man, died March 9. Dempsey began his career as a driller in 1901.

Frederick M. Griswold, 53, superintendent in Chanute, Kans., for Big Chief Drilling Co., died March 19 as a result of injuries received in an automobile accident.

Charles P. Shertzer, 87, retired Bartlesville, Okla., independent operator, died March 18 in a Bartlesville hospital.

Roy M. Barnes, 68, geologist with Continental Oil Co. for many years, died March 14 at his home in La Canada, Calif. Barnes was a past vice president of American Association of Petroleum Geologists.

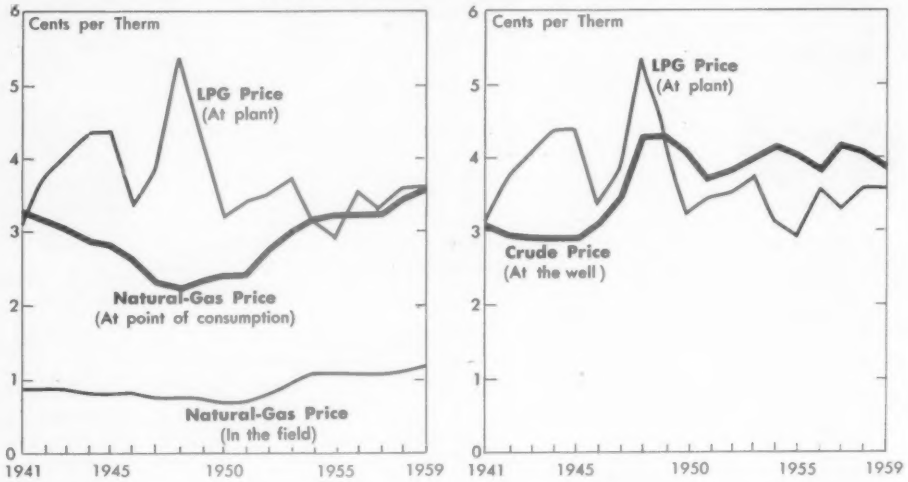
LPG PRICES, corrected for inflation, reached a peak in 1948. The average natural-gas price at point of consumption reached a low point the same year. The second chart shows that true-dollar crude prices also hit a postwar peak in 1948.

On an energy basis, LPG was priced above crude from 1942 until 1949. Starting with 1950, LPG has been cheaper than crude.

All basic prices are from USBM reports. The wholesale price index for all commodities other than farm and food was used to correct for inflation.

Prices for Competing Fuels

(Corrected for inflation, based on 1947-49 dollars)



Delivered gas price equals LPG at plant

BY JOHN C. CASPER

DOMESTIC DEMAND for LPG increased 19.0% last year despite handicaps that tended to limit distribution. One of the limits was the low price of natural gas.

About 54% of all LPG sales are to one or more of the following accounts: Domestic and commercial, industrial, or gas manufacturing. This is the type of customer who may use natural gas, if he can get it, or middle distillate.

Distribution of LPG to these customers is expensive. Aboveground storage is limited by cost, and most of the early underground storage was in the salt areas of the southwest. Mined caverns have made it possible to move the reserve supply a little closer to the customer, but winter transportation still is a major problem.

Here is one of the reasons why LPG can't compete with gas in some areas. It is shown on the first chart. Natural-gas prices at points of consumption average about the same as LPG prices at plants. Note that these two price series have been within the same general range since 1954. From 1942 through 1953, gas was much cheaper.

Prices on the chart are in cents per therm and corrected for inflation since 1947-49. A therm is 100,000 B.t.u.'s. The average LPG price for 1949 was 3.65 cents a therm at the plant. Natural gas at points of consumption averaged 3.62 cents per therm. In order for the LPG distributor to compete with gas in important market areas, he would have to transport and distribute without cost.

Note the wide year-to-year variations in LPG prices in contrast with the smooth curve for gas. The extreme price differential was in 1948 when gas sold for 2.26 cents a therm and LPG averaged 5.41 cents. Most gas is sold on long-term contract, but LPG prices fluctuate with the supply-demand balance. Note the low LPG price for 1955.

Gas prices at point of consumption have been rising rapidly since 1948. A large part of the increase has been due to big gains in deliveries to the high-price areas of the northeastern states.

Delivered prices for a particular area or state may be much lower now than in 1941 and slightly lower than in 1948.

For example, the average 1941 price for gas to residential customers in Illinois, Indiana, and Michigan was 12.12 cents a therm. The average had dropped to 9.88 cents by 1958. If the series is corrected for inflation, the price dropped from 19.03 cents to 7.71 cents. These corrected prices are in 1947-49 dollars.

The second chart shows that LPG also sells for less than the average price of crude at the well. Crude-processing costs are offset by the high cost of storing and distributing LPG.

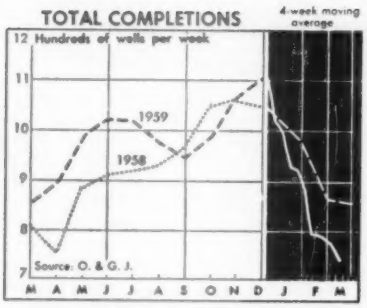
The lowest inflation-corrected price for LPG over the past 20 years was in 1955 when the average was down to 3.27 cents a gallon in current dollars or 2.95 cents a therm corrected to 1947-49 dollars.

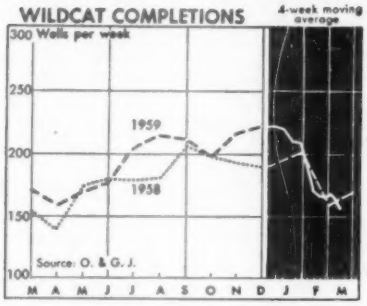
Despite keen competition, plant operators are expecting another good LPG year in 1960.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,160,744	UP	72,364	DOWN	53,130
Crude stocks	254,234,000	UP	1,519,000	DOWN	1,438,000
Completions	741	UP	56	DOWN	154
Refinery runs	7,857,000	UP	75,000	DOWN	225,000
Gasoline stocks	224,464,000	UP	3,339,000	UP	12,325,000
Kerosine stocks	18,784,000	DOWN	1,752,000	UP	451,000
Distillate stocks	82,442,000	DOWN	8,734,000	UP	5,248,000
Residual stocks	40,991,000	DOWN	2,236,000	DOWN	14,091,000
Four-product stocks	366,681,000	DOWN	9,383,000	UP	3,933,000
Total imports	1,957,300	UP	191,800	UP	25,500

*Product stocks for March 4 revised.





Active Rotary Rigs

	3-21-60	3-14-60	3-23-59
Alabama	5	5	8
Arkansas	11	12	17
Arizona	2	1	1
California	82	80	99
Land	80	79	96
Offshore	2	1	3
Colorado	23	19	28
Florida	2	2	3
Land	1	1	2
Offshore	1	1	1
Illinois	18	17	17
Indiana	3	4	7
Iowa	0	0	2
Kansas	86	107	130
Kentucky	4	4	6
Louisiana	302	287	324
North	26	26	33
S. Inland waters	130	127	142
S. Land	93	81	111
Offshore	53	53	38
Maryland	0	0	1
Michigan	37	37	13
Mississippi	69	67	68
Missouri	0	0	0
Montana	16	16	19
Nebraska	25	24	25
Nevada	0	0	0
New Mexico	80	93	108
New York	2	0	0
North Dakota	19	13	43
Ohio	4	3	1
Oklahoma	176	175	215
Oregon	0	0	0
Pennsylvania	7	6	11
South Dakota	1	1	1
Texas	622	590	759
S. Inland waters	9	8	8
S. Land	167	162	165
Offshore	2	2	0
North	42	39	158
East	55	34	(*)
Panhandle	42	48	(*)
West Central	205	199	264
West	100	98	164
Utah	30	26	39
Washington	0	0	0
West Virginia	5	5	5
Wyoming	52	57	53
Total U. S.	**1,683**	1,651	2,003
Western Canada	217	232	199
Eastern Canada	3	3	0
Grand total	1,903	1,886	2,202

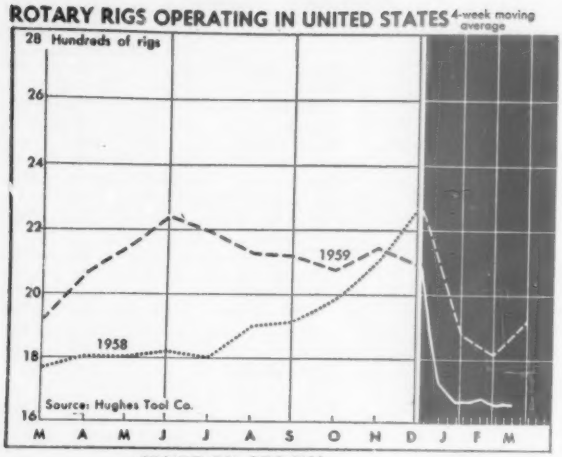
Hughes Tool Co. report. *Included in North. Comparisons not available due to change in method of reporting.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 19, 1960

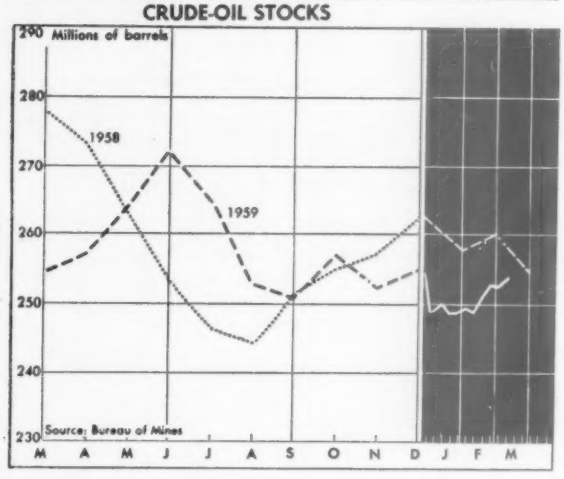
	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1960	1959	Total	Crude	Cond.	Gas	Dry	1960	1959
Alabama	6	6	0	0	0	0	69,669	14	28	0	0	0	0	0	1	4
Arizona	0	0	0	0	0	0	0	6	.....	0	0	0	0	0	6	.....
Arkansas	2	0	0	0	2	0	5,413	127	208	1	0	0	0	1	34	35
California	24	12	0	2	10	0	135,330	284	348	7	0	0	0	7	66	81
Colorado	10	2	0	2	6	0	54,866	156	164	2	0	0	0	2	71	90
Illinois	31	13	0	0	18	0	58,348	513	501	10	0	0	0	10	136	84
Indiana	5	3	0	0	2	0	4,949	200	142	2	0	0	0	2	81	44
Kansas	32	12	0	1	19	0	119,126	715	892	18	3	0	0	15	229	204
Kentucky	18	9	0	3	6	0	26,771	460	380	4	2	0	0	2	54	42
Louisiana	58	27	5	3	23	0	461,311	708	809	5	0	0	0	5	99	109
North	17	13	0	1	3	0	56,381	223	292	1	0	0	0	1	41	52
South	34	12	4	2	16	0	326,528	364	431	4	0	0	0	4	52	54
Offshore	7	2	1	0	4	0	78,402	121	86	0	0	0	0	0	6	3
Michigan	15	7	0	0	8	0	52,289	161	125	4	0	0	0	4	53	37
Mississippi	16	7	1	1	7	0	161,484	169	141	4	0	0	0	4	61	64
Montana	4	2	0	0	2	0	16,672	56	59	2	0	0	0	2	28	25
Nebraska	12	2	0	0	10	0	65,936	162	159	5	0	0	0	5	66	72
New Mexico	34	22	2	3	6	1	166,087	418	382	2	0	0	0	2	58	40
West	11	4	2	3	2	0	45,712	138	.....	2	0	0	0	2	13	.....
East	23	18	0	0	4	1	120,375	280	.....	0	0	0	0	0	45	.....
New York	0	0	0	0	0	0	0	72	74	0	0	0	0	0	5	4
North Dakota	4	3	0	0	1	0	32,187	65	94	1	1	0	0	0	11	24
Ohio	10	5	0	1	4	0	17,203	252	202	1	0	0	0	1	13	5
Oklahoma	70	24	2	8	34	2	323,977	817	1,301	12	2	1	1	8	159	210
Pennsylvania	61	21	0	23	9	8	173,489	128	114	1	0	0	1	0	6	3
South Dakota	0	0	0	0	0	0	0	10	.....	0	0	0	0	0	4	.....
Texas	287	160	15	11	89	12	1,291,902	3,489	4,110	44	0	0	2	42	708	783
Dist. 1	16	11	0	1	4	0	33,078	250	263	1	0	0	1	0	86	69
Dist. 2	19	4	5	3	7	0	129,858	147	161	5	0	0	0	5	38	49
Dist. 3	15	8	2	0	5	0	95,842	275	237	3	0	0	0	3	54	69
Dist. 4	22	3	3	2	13	1	120,535	271	272	8	0	0	0	8	82	81
East	21	11	1	0	9	0	133,186	265	243	6	0	0	0	6	56	60
Dist. 7-B	42	18	0	1	16	7	109,893	476	530	6	0	0	0	6	135	144
West	83	63	3	0	17	0	448,753	934	1,309	8	0	0	0	8	145	144
Dist. 9	43	24	1	1	13	4	122,115	635	783	4	0	0	0	4	92	135
Dist. 10	26	18	0	3	5	0	98,642	236	312	3	0	0	1	2	20	32
Utah	3	2	0	0	1	0	12,136	60	90	1	0	0	0	1	22	23
West Virginia	17	0	0	13	4	0	35,437	191	160	0	0	0	0	0	1	5
Wyoming	18	9	0	0	9	0	101,417	217	191	11	2	0	0	9	89	74
Misc. (Mo., Iowa, Alaska)	4	2	0	0	2	0	18,536	10	15	4	2	0	0	2	9	12
Total U. S.	**741**	350	25	71	272	23	3,404,535	9,460	10,689	**141**	12	1	4	124	2,070	2,074
Previous week	685	351	26	44	259	5	3,067,518	.....	.....	146	11	1	3	131	.....	.....
Cum. 1960	9,460	4,414	308	841	3,605	292	41,180,434	.....	.....	2,070	189	20	62	1,799	.....	.....
Cum. 1959	10,689	5,390	275	738	3,998	288	45,333,117	.....	.....	2,074	225	28	68	1,753	.....	.....
Western Canada	54	38	0	4	12	0	284,830	538	531	14	2	0	3	9	155	198

PRODUCTION

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	3-12-60	3-5-60	3-14-59
Pennsylvania	2,179	2,212	2,515
Other Appalachian	1,920	1,985	1,336
Illinois, Indiana, Michigan	9,254	9,607	8,405
Nebraska and North Dakota	2,436	2,615	2,156
Kansas	9,164	9,075	8,711
Oklahoma	17,051	16,855	16,439
Arkansas	2,023	2,101	1,856
Louisiana	19,317	19,556	17,727
North	3,180	3,086	2,909
South	16,137	16,470	14,818
Mississippi, Alabama, Florida	2,765	2,889	2,629
New Mexico	7,933	7,628	8,465
Texas	109,788	107,215	113,141
East Texas	8,206	7,890	8,574
West Texas	50,691	49,767	56,374
Texas Gulf	19,572	18,105	18,712
Other Texas	31,319	31,453	29,481
Wyoming	16,876	17,382	12,870
Other Rocky Mountain	9,584	9,324	9,353
California	29,768	29,510	34,793
Foreign	†14,176	14,761	15,276
Total	**254,234**	252,715	255,672

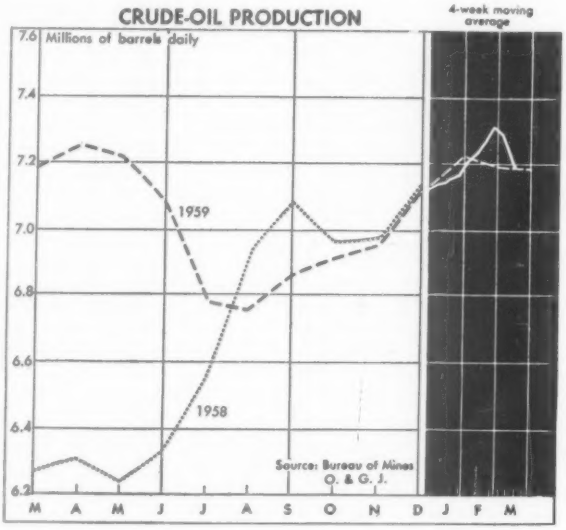
*Bureau of Mines. †Includes 4,150,000 bbl. in California.

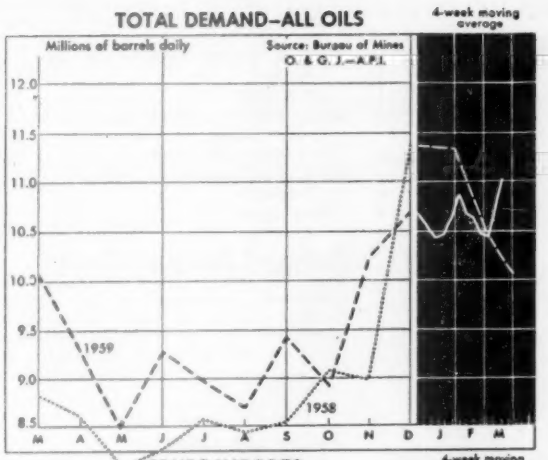
DAILY AVERAGE PRODUCTION FOR WEEK

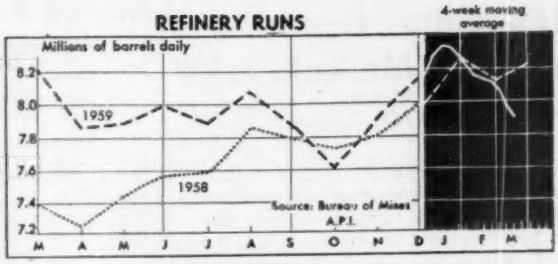
	March 19, 1960			Mar. 12
	Crude oil	Lease condensate	Total	total
Alabama	19,375	.....	19,375	19,300
Arkansas	82,975	300	83,275	83,100
California	830,100	.....	830,100	828,300
Colorado	130,100	.....	130,100	129,000
Eastern	36,800	.....	36,800	37,600
Florida	1,200	.....	1,200	1,200
Illinois	215,300	.....	215,300	216,500
Indiana	32,900	.....	32,900	33,700
Kansas	†309,844	.....	†309,844	†258,930
Kentucky	66,400	.....	66,400	67,500
Louisiana	963,700	133,700	1,097,400	1,097,900
North	108,700	6,200	114,900	115,400
South	855,000	127,500	982,500	982,500
Michigan	31,600	.....	31,600	31,600
Mississippi	134,100	4,225	138,325	138,325
Montana	80,900	.....	80,900	80,500
Nebraska	62,300	.....	62,300	63,000
Nevada	100	.....	100	100
New Mexico	306,600	8,500	315,100	315,100
North Dakota	50,100	.....	50,100	51,300
Oklahoma	†533,550	.....	†533,550	†508,700
Texas	2,583,000	91,625	2,674,625	2,674,625
Dist. 1	41,000	3,500	44,500	44,500
Dist. 2	114,000	9,100	123,100	123,100
Dist. 3	325,000	38,000	363,000	363,000
Dist. 4	190,000	17,000	207,000	207,000
Dist. 5	29,000	500	29,500	29,500
Dist. 6	114,000	10,000	124,000	124,000
East Texas field	139,000	.....	139,000	139,000
Dist. 7-B	137,000	300	137,300	137,300
Dist. 7-C	127,000	3,525	130,525	130,525
Dist. 8	1,067,000	6,000	1,073,000	1,073,000
Dist. 9	192,000	2,400	194,400	194,400
Dist. 10	108,000	1,300	109,300	109,300
Utah	110,100	.....	110,100	109,400
Wyoming	340,000	.....	340,000	341,400
Others	‡1,350	.....	‡1,350	‡1,300
Total U. S.	6,922,394	238,350	**7,160,744**	7,088,380
Change from previous week, up			**72,364**	
Canada	†597,500	.....	†597,500	†513,100
Total U. S. production—Jan. 1-Mar. 19				570,112,600 bbl.
Same period last year (crude plus cond.				*561,976,900 bbl.

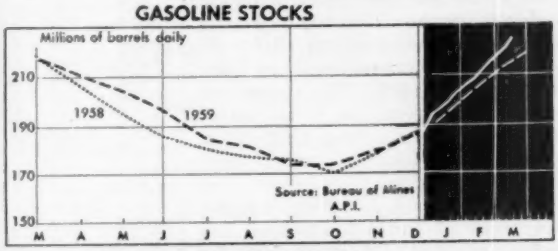
*Includes 15,370,200 bbl. condensate. †Week ended previous Monday. ‡Alaska and South Dakota.

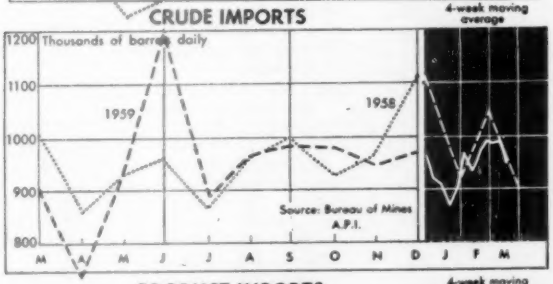
CRUDE-OIL PRODUCTION

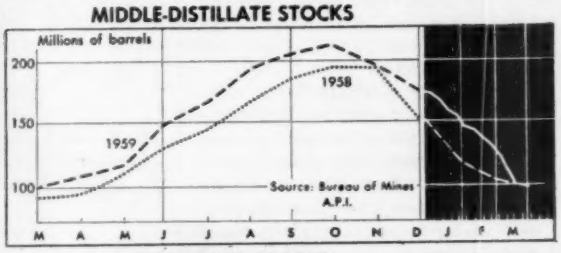


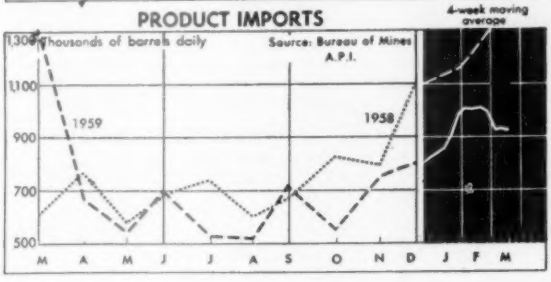


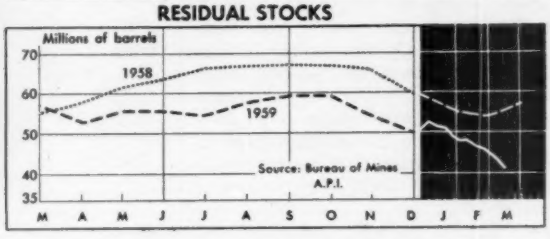












API REFINERY REPORT—MARCH 18, 1960

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1959 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,084	515.0	37.0	334.4	197.7	46,363	7,154	26,619	10,389	1,202	534.5	49.1	394.9	191.5
Appalachian:														
District 1	101	38.2	4.4	21.4	10.9	6,056	487	1,965	249	104	41.6	4.6	24.6	10.6
District 2	110	49.0	7.4	21.9	18.0	3,137	312	818	431	103	48.0	8.2	17.2	18.3
Ind., Ill., Ky.	1,431	692.2	59.3	307.6	183.0	44,033	3,221	12,615	3,648	1,519	759.1	72.3	332.3	192.4
Minn., Wis., Dak.	127	63.0	9.4	27.4	19.9	6,848	612	2,910	575	103	50.0	5.4	25.8	10.6
Okla., Kans., Mo.	692	395.4	16.7	168.2	40.4	23,168	792	7,241	900	738	395.8	13.7	184.3	26.2
Inland Texas	281	197.4	12.6	53.4	18.4	8,118	499	1,649	2,407	272	200.4	6.2	41.2	21.9
Tex. Gulf Coast	1,846	888.9	120.7	398.2	137.9	28,618	2,232	9,702	5,132	1,927	925.8	100.4	488.7	181.8
La. Gulf Coast	653	366.4	43.3	206.7	34.0	11,962	1,607	3,245	1,108	700	379.2	31.2	187.5	51.1
N. La. and Ark.	98	40.1	5.0	20.1	7.9	5,741	362	2,446	137	102	49.2	5.0	24.1	6.3
Rocky Mtn:														
New Mexico	28	17.4	.71	4.4	4.3	789	75	152	164	25	12.5	.50	4.4	2.5
Other	275	125.9	5.2	60.0	28.1	7,851	234	2,396	879	295	134.6	3.8	63.5	38.6
West Coast	1,131	570.0	37.0	215.4	303.1	31,780	1,197	10,684	14,972	1,117	499.7	5.5	198.9	298.7
Mar. 18, 1960	7,857	3,958.9	358.7	1,839.1	1,003.6	224,464	18,784	82,442	40,991	8,207	4,030.4	305.9	1,987.4	1,050.5
Mar. 11, 1960	7,782	3,948.9	353.7	1,735.6	1,068.1	221,125	20,536	91,176	43,227	.....	.....	.....	.....	.....
Mar. 20, 1959	8,082	4,084.6	271.7	2,072.4	1,034.1	212,139	18,333	77,194	55,082	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

It's winter this spring. Markets are crazy, too.

THE WEATHER MAN has cooperated in the reduction of distillate fuels. March continued to roar like a lion for middle distillates on the East Coast and total light fuels were reduced roughly 23,000,000 bbl. in the 2 weeks ended March 19.

There was no "roar" in prices. They were weak, lamblike. There were two spot cargo sales of No. 6 fuel during the week at the posted Gulf Coast price. There were no other cargo sales to test prices, only barter.

With the arrival of spring, it is exit for barter of No. 2 for gasoline and entry for barter of diesel fuel for gasoline. Kerosine was bartered for gasoline last week at close-to-posted lows for respective products.

Barter is the hallmark of an oversupplied, weak product market. Barter saves transportation, conserves cash, and does not undermine posted prices.

Except for West Coast delivery, there is no cargo activity on the Gulf Coast in light products. Only No. 6 fuel is selling at the posted price. It is the one bright spot in the Gulf Coast market. Garden variety is firm at $2.00 a barrel, the posted price, and low-sulfur No. 6 is very firm at the $2.25 posted price.

Last week the Government gave an assist to the heavy-fuel market when it assured coal interests that residual quotas would not be eased. The New York Harbor market reacted immediately with buyers offering $2.25 to $2.35 against a $2.10 posted price.

Mississippi River markets are oversupplied, weak, and confused. Gasoline on the river is quoted at 0.375 cent off Gulf Coast but it takes an offer to sell at 0.5 to 0.75 cent off Gulf Coast to interest spot buyers. Material is available at these prices.

No. 2 fuel price on the river, like halitosis, is not discussed. It is as weak as gasoline and weaker at ½ to ¾ cent off Gulf Coast. Material is there at these prices, dependent on location.

Group 3 gasoline for northern movement is pretty firm. Posting is 11.25 cents per gallon, subject to not more than 0.25-cent discount.

Spot No. 2 fuel is selling for about 8.25 cents a gallon, Group 3. There are rumors of movement at 8.00 cents, but these may be tag ends of sales made earlier in the month. No. 1 fuel is a little scarce along the pipeline.

Crude-Oil Prices

GRAVITY SCHEDULE

	Signal Hill, Calif.	Okla-homa	Gulf Coast Tex.*	West Tex.† N.M.	Wyo. (sour)
14-14.9	$1.76	....	....	....	....
15-15.9	1.84	....	....	....	$1.81
16-16.9	1.92	....	....	....	1.86
17-17.9	2.00	....	....	....	1.91
18-18.9	2.08	....	....	....	1.96
19-19.9	2.16	....	....	....	2.01
20-20.9	2.24	$2.49	....	$2.35	2.06
21-21.9	2.32	2.52	....	2.38	2.11
22-22.9	2.39	2.55	....	2.41	2.16
23-23.9	2.46	2.58	$3.44	2.44	2.21
24-24.9	2.53	2.61	3.46	2.47	2.26
25-25.9	2.60	2.64	3.48	2.50	2.31
26-26.9	2.67	2.67	3.50	2.53	2.36
27-27.9	2.74	2.70	3.52	2.56	2.49
28-28.9	2.81	2.73	3.54	2.59	2.54
29-29.9	2.87	2.76	3.56	2.62	2.59
30-30.9	2.93	2.79	....	2.65	2.63
31-31.9	3.00	2.82	....	2.68	2.67
32-32.9	3.06	2.85	....	2.71	2.71
33-33.9	3.12	2.88	....	2.74	2.75
34-34.9	3.17	2.91	....	2.77	2.79
35-35.9	3.22	2.94	....	2.80	2.83
36-36.9	3.27	2.97	....	2.83	2.87
37-37.9	3.31	2.99	....	2.86	2.89
38-38.9	....	3.01	....	2.89	2.91
39-39.9	....	3.03	....	2.92	2.93
40-40.9	....	3.05	....	2.95	2.95

*Low cold test crude. †Sour.

Effective dates of broad changes: California, 9-11-59; East of California, January 3-10, 1957; Pennsylvania Grade 1-11-60.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.55
Middle District	4.37
Southwest Pennsylvania	4.10
West Virginia	3.92
Buckeye Grade	3.77
Illinois Basin	**3.00**

FOREIGN

Canada:	
Leduc-Woodben	2.53
Redwater (Alta.)	2.42
Smiley (Sask.)	2.18
Pembina	2.38
Venezuela:	
Cumarebo, 48°-9°, Tucupido	3.34
San Joaquin, 41°-41.9°, Puerto La Cruz	3.08-3.10
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes f.o.b. lifting port):	
Arabian, about 34°, Ras Tanura	$1.90
Iranian, 34.0°-34.9°, Bandar Masur	1.80
Iranian, 34.0°-34.9°, Abadan	1.81
Iraq, 36.0°-36.9°, Fao	1.82
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.67
Qatar, about 41°, Um Said	2.05
Middle East, E. Mediterranean:	
Arabian, about 35°, Sidon	2.29
Iraq, about 35°, Tripoli, Banias	2.29
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.57

Refined-Product Prices

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (91 octane)	11.00-11.25
Premium (99 octane)	13.50-14.00
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.25-10.50
Regular (92 octane)	10.50-10.75
Premium (98 octane)	11.50-11.75
California (rack) Los Angeles):	
Regular (88 octane)	11.65-12.15
Premium (94 octane)	12.65-13.15
Premium (100 octane)	14.00-14.65
Caribbean area (cargoes):	
Regular (87 octane)	10.125
Premium (97 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
★ Kerosine 42-44	9.50
★ Diesel oil (58 d.i. and above)	9.25
★ Distillate No. 1	9.25
★ Distillate No. 2	8.25
Gulf Coast (cargoes):	
Kerosine 41-43	8.75- 9.00
Distillate No. 2	7.75- 8.00
New York Harbor (barges):	
Kerosine 41-43	9.8-10.3
Distillate No. 2	8.8- 9.3
Diesel fuel, 48-52 d.i.	9.1- 9.6
Caribbean area (cargoes):	
Distillate No. 2	8.00

RESIDUAL FUEL (BBL.)

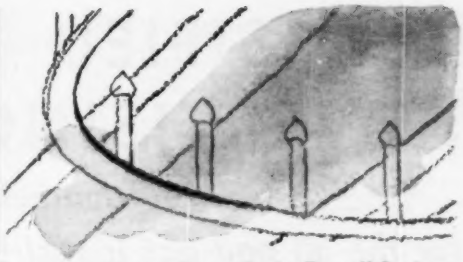
Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.70-1.80
Gulf Coast (cargoes):	
Bunker C fuel	$2.00
New York Harbor (barges):	
Bunker C fuel	$2.37
Caribbean (cargoes):	
Bunker C	$2.00
California (rack):	
Bunker C fuel, Los Angeles	$2.15

Tanker Rates (Long Ton)

(Latest reported spot fixtures)

★ Gulf-N. Y., clean (ATRS+5%)	$2.99
★ Carib.-N. Y., dirty (ATRS—55%)	1.24
Carib.-UK, dirty (Scale—52.5%) (15s. 5d.)	2.16
PG-UK, dirty (Scale—62.5%) (24s. 2d.)	3.39

"When we talked about the Plan person-to-person, participation jumped 30%!"

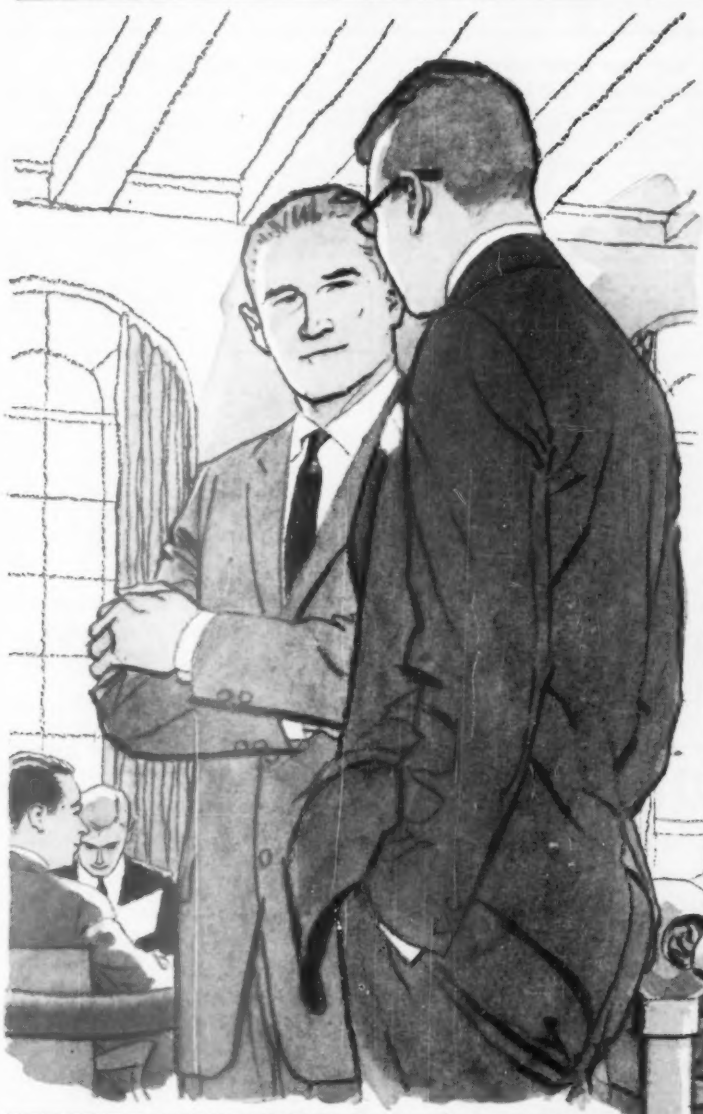


In our company we've made the Payroll Savings Plan available for some time. I thought, naturally, that we had a large participation. But when I checked up a few weeks ago I discovered that only about 22% of our people were making use of the Plan. It's so easy to say, "Sure, this is a fine idea, and I'll sign up next payday."

What our people needed was someone to explain this convenient savings plan *in person;* someone to show them that just signing the card would put this fine thrift program into automatic operation. They needed somebody to invite them to *start right now.*

When I contacted our State Savings Bonds Director, he helped us set up a thorough, informative canvass of everybody on our staff. As a result more than 30% additional employees signed up for this easy, systematic way to buy U.S. Savings Bonds, *regularly.*

Perhaps *your* organization, too, has a large percentage of employees who have *never been invited* to combine patriotism with basic thrift through the Payroll Savings Plan. Companies with high employee participation are enthusiastic about its benefits in terms of lower employee turnover, better safety records, and the satisfaction engendered by helping large numbers to contribute to our Nation's Peace Power. The greater your employee participation, the more substantial your company benefits will be. Contact your State Savings Bonds Director for prompt, practical help in spreading Payroll Savings information, *person-to-person.*



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WELL DRILLS—CORE DRILLS. Everything for well and core drilling in both new and used equipment at money saving prices. Fishing tools rented. Send for bulletins. Pressey & Son, Pueblo, Colo.

FOR SALE—Excellent Water Flood Prospect, Located Old Somerset Field, Atascosa County, Texas. Leases are ⅞ and adjoining. 2,600 acres of the 3,000 acre block are unitized.
Three producing and one input well on premises.
Best sand is Olmos at 1,500'. Sand thickness 20-30'. Oil in place, 1,200 bbls. per acre foot with 600 estimated receivable with effective water flood. Treated salt water moves oil through cores.
Interested buyers may make contact in person only.
Texas Drillers, Inc., P. O. Box 47, Seguin, Texas. Ph. FR 9-5131.

FOR SALE: Oil loading rack, six railroad cars 200 ft. long, complete with 4 inch supply pipe, 3 inch laterals, valves and swing pipe. Fair Oil Co., Box 689, Tyler, Texas, Telephone LY 2-3811.

A LIMITED quantity Westinghouse 10 H.P., 1150 R.P.M., 3 phase, 60 cycle, 220/440V, high starting torque, totally enclosed, fan cool, oil well pumping motors reconditioned in our shop, $195.00 each for 1 to 4 motors, $175.00 each 5 or more, F.O.B. San Antonio. Loyd Electric Company, Inc., Phone CA 7-1309.

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3350 Sq. Ft. BRAUN 135PSI, #66510 Type 42-192, 1064-¾" OD Tubes 16 ft. long, 14 Ga., Steel ASTM-A-179 Excellent Condition, LOW PRICE.
S. M. Davis, Box 1407, E. St. Louis, Ill.

PIPE FOR SALE
15,000 ft., 5½" OD-15.5#, J55, Long Coupling
5,000 ft., 7" OD-20#, J55
10,000 ft., 2⅜" OD-4.7#, J55, EUE Tubing
Sucker rods, line pipe, tanks and pumping units.
All No. 1 Grade—Used
29,000 ft., 4½" OD-15.5#, SS, 30 ft. PE Tubing—New
Lundquist Pipe & Supply Co.
325 Wright Bldg., Tulsa, Okla., Phone LU 5-8850

GAS COMPRESSORS

9"x9" Ingersol-Rand ES-1 with MZAU Waukesha engine, fabricated by Wilson & Co., new condition. Maximum discharge on cylinder 100#, $6,000
8"x13" Gardener-Denver, new condition, with brand new Catipillar G 342 Engine. Maximum discharge 750#. Equipped with all extras. Fabricated by IFS, $15,500
4¼"x9" Ingersol-Rand ES-1 with D-1000 LeRoi Engine. Maximum discharge 500#. Fabricated by IFS, $6,000
(Any of the above cylinders could be changed to any desired size and discharge pressure.)

Cylinders only
6⅛"x11" Ingersol-Rand. Discharge pressure 440#, tested 660#
17"x13" Worthington. Discharge pressure 60#
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Fabrication of New & Used Compressors.

INDEPENDENT FIELD SERVICE
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1 BUCYRUS—ERIE 36L Spudder, late model. Rig complete with tools and equipment. Cassel Drilling Co., Inc., Dumas, Texas. Phone WE 5-5019 or WE 5-4369.

FOR SALE—Approx. 150,000 ft. 6⅝" O.D. 18.97# Used Line Pipe, S. R. L. Bevelled for Welding. Address inquiries P. O. Box 2205, Tulsa, Oklahoma.

8,350 ft. 2⅞" EUE seamless 8R thread, used tubing: 60 cents per ft. 3,000 ft. 2⅞" ditto, 10 thread: 55 cents per ft. Located Elk City, Okla. 1,200 ft. 4" O.D. full hole drill pipe: 60 cents per ft. Located Blackwell, Okla. Carman Supply Co., Phone RIverside 2-3502, 1008 E. 36th St., Tulsa.

1956 MAYHEW 2000 mounted International 190 Tandem, Completely equipped, all tools. $17,500. Located Farmington, N.M. Call or write Bellet, Tulsa, Okla., LUther 2-6291 or P. O. Box 1049.

FOR SALE: Blaw-Knox Packaged Gasoline Stripping Plant, capacity: 5 million cubic feet per day. Complete less storage tanks. Location Central Oklahoma. Okla. Resources Development Co., Box 3966, Okla. City 6, Okla

SELL OR LEASE—IDEAL EXPLORATION TRUCK

In completely new condition, 1959 Ford ¾ ton, 4 wheel drive, six-man cab, custom built. Used for one African safari. Equipped with warn hubs, utility body, two 12-volt generators, two batteries, one 110-volt generator, air conditioned, power brakes, clutch and steering, air compressor, 60 gallon water and 70 gallon gasoline tanks.
Cost $8,200, sell $5,000 or will lease. Dallas L. Calmes, P. O. Box 191, Houston—CA 3-4161.

3,000' OF GOOD used 2⅞" x 20' Grade D Drill Pipe complete with 2⅞" IF tool joints @ $1.75 per foot. Rhodes Drilling Company, Abilene, Texas, ORchard 2-2839.

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BLOWERS Cent. 28,000 CFM at 17 Psig.
COMPRESSORS, Clark Gas RA-5; Clark Cent. 7,860 CFM 2 Stage
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306 Thompson Bldg., Tulsa 3, Okla.
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FOR SALE EQUIPMENT

18" AND 20" good used pipe. Very attractive prices. Contact: The Tri-State Pipe Co., Bellaire, Ohio. Telephone OR 6-1452.

FOR SALE OR LEASE: Three (3) large perforating trucks complete with 16,000' of 7/16" single conductor line. These units are ready for the field. Box L-614, The Oil and Gas Journal, Tulsa, Oklahoma.

ASPHALT UNIT—1,000-barrel capacity consisting of vacuum pump, complete with vacuum jugs and 2 vacuum towers, 20-horsepower GE 22/440 volt motor; one 3,000-barrel and two 2,000-barrel all welded tanks insulated; miscellaneous asphalt heaters; cooling tower; loading racks; lab equipment, etc. Write Box 637, Hardin, Montana. Phone 642.

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2,000,000 ft.	2"	3.50# to the ft.
1,000,000 ft.	3"	7.70#
1,000,000 ft.	4"	10.98#
500,000 ft.	6"	19.80#
200,000 ft.	8 5/6"	28#
400,000 ft.	10¾"	35#
75,000 ft.	12¾"	40#
10,000 ft.	16"	42#

All No. I Grade plain end and cleaned.

INDIANA-OHIO PIPE CO.
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Columbus 19, Ohio
Phone CL 3-5527

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19,000 BBL. MIV CAT CRACKER (1953)

BOILERS, 5—70,000 #/hr. 450 Psi.
HORTONSPHERES, 6—5,000 & 10,000 bbl.
EXCHANGERS, 78 to 4,000 sq. ft.
TOWERS, 3 ft. to 12 ft. diameter.
VESSELS, 2 ft. 3 in. to 15 ft. 6 in. diameter.
FURNACES, 15 MM & 34 MM BTU/hr.
CENT. COMPRESSORS, 38,000, 9,370 & 5,535 CFM.
CENT. PUMPS, 15 to 7,000 GPM.
TURBINES, 5 to 1,400 HP.
TANKS, 1,000 to 80,000 bbl.
ETHYL WEIGHING STATION, 8,500 gal.

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WANTED: Gardner Denver 5 x 10 pump, with high pressure fluid end. Also Triplex Plunger pumps. Write P. O. Box 65, Clarkwood, Texas.

WANTED: 50 H.P. Reda pump complete, in working condition. Box L-760, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

"MEASUREMENT SUPERINTENDENT; responsibility includes repair, adjustment and testing of domestic and industrial meters, regulators, pressure volu correctors, etc. Also, fabrication and installation of industrial meter settings. Must be experienced and aggressive. Send details of experience and compensation. Location Great Lakes Area." Box L770, The Oil and Gas Journal, Tulsa, Oklahoma.

NEW OIL JOB Directory, foreign and domestic, showing where to apply for jobs. 500 selected producing, refining, butane and pipeline companies. Nationwide, $6.00 cash. OIML Co., Box 2603, Tulsa, Oklahoma.

ESTIMATOR—Pressure Vessels and Heavy Steel Fabrication. Familiar with A.S.M.E. Codes. Growing Company. Send resume to: Cherokee Steel, Inc., P. O. Drawer 1049, Tulsa, Okla.

LAND MAN to be in charge of securing options and leases for large reputable mining firm conducting exploration in Missouri. Full time job, several years experience preferred, salary open. Send work references with application. Reply to: Box L-750, The Oil and Gas Journal, Tulsa, Oklahoma.

NEED FOREIGN sales representation for our complete line of new and revolutionary gas lift equipment. Excellent commissions. Box L-759, The Oil and Gas Journal, Tulsa, Oklahoma.

TRANSLATORS, Proven ability to translate technical material into fluent English essential. Attractive full time or free-lance arrangement. All languages of interest, particularly Russian. Send resume to: A•T•S, Inc., Drawer 271, East Orange, N.J.

Representatives wanted by manufacturer of production equipment for Rocky Mountain, Four Corners, Illinois, Michigan, South America and Mexico. Give list of accounts now handled and method of coverage. Box L-779, The Oil and Gas Journal, Tulsa, Oklahoma.

FOREIGN—DOMESTIC Employment Oil, Chemical, Industrial. Write for details without obligation. Accredited Personnel Services, P. O. Box 6006, New Orleans 14, La.

WANTED
PRODUCTION SUPERINTENDENT
or
PETROLEUM ENGINEER

Must be experienced in all phases of production, water-flooding, drilling, well completion and workover in Oklahoma. Salary open. Address reply: Box 1160, Tulsa, Oklahoma.

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M.S. and Ph.D.—Physical Chemists, Physicists, Chemical Engineers, Petroleum Engineers, and Mechanical Engineers; 0 to 5 years' experience—fundamental and applied research in hydraulics, petrophysics, surface chemistry, reaction kinetics, and photoelasticity.

New facilities, suburban location, excellent opportunities, liberal publication policy, generous employee benefits, salaries commensurate with qualifications.

Please apply by letter, giving details of your training and experience by writing to: Box L768, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

GEOLOGISTS

Medium size integrated oil company has openings for two capable geologists between 28 and 40 years of age. One must have varied experience in south Louisiana; the other in south Texas area. Salary range of $9,000 to $13,000. Submit resume, including references, recent photograph and salary requirements to:

BOX L-783
THE OIL AND GAS JOURNAL
TULSA, OKLAHOMA

All replies are strictly confidential, and our employees know of this advertisement.

OVERSEAS OPPORTUNITY

Oil Company operating in Libya has opening for experienced WAREHOUSEMAN-CLERK. Must be thoroughly familiar with drilling and production equipment and supplies and be able to train and supervise native personnel. Will be required to set up and maintain perpetual inventory records. Ability to type essential. Write P. O. Box 1262, Dallas, Texas, giving age, marital status, and complete and detailed resume of education and experience. Enclose small snapshot.

REFINERY MAINTENANCE: Two men, one possibly for Maintenance Superintendent, with several years general experience in all phases refinery maintenance: covering, welding, pipe fitting, pump and compressor repairs, instrument, electrical, boiler making, rigging, etc. Mechanical Engineering Degree desirable but not necessary if otherwise qualified. Must be capable of doing work in the crafts themselves, also organizing, training, and supervising our Puerto Rican employees. Salary commensurate with experience and ability. Make application to E. G. Case, Vice-President, Manufacturing, Caribbean Refining Company, Box 2988, San Juan, Puerto Rico.

SITUATIONS WANTED

DEVELOPMENT ENGINEER and Former manager, drilling contractor's operations, South America and coordinator oil company's development program, Middle East, desires position in exploration/drilling/production in supervisory/administrative/engineering capacity domestic or overseas, or technical representative equipment manufacturer or service company abroad. Available now. Speaks Spanish, German and some French. Resume on request: Box 31R, 547, 4041 Marlton Ave., Los Angeles 8, California.

GEOLOGICAL Engineer, 36, family, 15 years varied exploration experience, including some foreign, mining, and hydrodynamic work, speaking fluent French, working Spanish, seeks position, domestic or foreign, expenses & interest only, if preferred. Box L766; The Oil and Gas Journal, Tulsa, Okla.

GEOPHYSICIST: B.S. Geology. 9 years experience includes Party Chief and review in Texas, Louisiana, New Mexico. Available. Box L-758, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERT LANDIS pipe mach. opr. and torch burner wants position. Box L-780, The Oil and Gas Journal, Tulsa, Oklahoma.

COMMERCIAL PILOT, 27 mel instrument 2,900 hrs. B-25, Convair, military obligation complete. BA ECO 1954 desire challenging position—executive pilot—public relations—available immediately. L. R. Kuhnell 7051 Twin Hills, Dallas, Texas, EM 1-1427.

RESERVOIR ENGINEER: hard working conscientious 5 years experience including reserves, economics, development, secondary recovery, workovers and proration. Box L-781, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: with experience as chief engineer, and production-operations superintendent, both foreign and domestic. Fluent Spanish. Age 43. Desire responsible engineering or operations foreign assignment, preferably South America. Box L-782, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

PETROLEUM ENGINEER, also qualified as geologist. 17 years of responsible domestic and foreign experience. Speaks French and Spanish. Desires senior technical or administrative position in foreign operation of producing company. Box L-776, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER, 9 years experience, all phases natural gasoline process engineering and operation supervision—gas treating, fractionation, sulfur plant, LPG handling and testing, above ground and solution cavern storage. Desires responsible position with established firm. Box L-777, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

Oil Property Management, Lease evaluations, completion and workover supervision—Permian Basin and South Eastern New Mexico. Bee Engineering, P. O. Box 5321, Village Station, Midland, Texas.

MONTGOMERY County Kansas, 80 acres partially proven, 750 ft. Bartlesville Sand. For logs write Box 121, Pawhuska, Oklahoma.

14 OIL WELLS, 5 water injection wells. 560 acres. Production, approximately 20 barrels daily. 700 ft. depth. On pipeline. Engineers say drilling additional wells will make a money making, long lived flood. Southeast, Kansas. Box L-715, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL AND GAS MINERAL LEASES available in Dell City area of Hudspeth County, Texas. U. S. Geological Survey Map shows anticlinal axis nearby favorable for oil-gas structure. Am fee landowner of over 2,000 acres. Write quickly to: Jefferson G. Smith, 715 Littlefield Building, Austin 15, Texas.

HAVE 170 ACRES Commercial lease N.E. of Twp 13 R 12 E Okmulgee Co., Okla. For sale reasonable. George Hedges, Sr., Box 121, Pawhuska, Oklahoma.

FOR SALE or drilling interest: Arizona oil and gas leases (Federal), Coconino County, 640 acres T17N, R13E, 586 acres T17N, R14E. Write: Box L-708, The Oil and Gas Journal, Tulsa, Oklahoma.

CLINTON COUNTY Kentucky hotspot—135 acre farm-out. Small cash bonus and override. Sell 86 acres and 240 acres. $30.00 per acre cash $30.00 Oil payment 1/16 override. Write: Box L-761, The Oil and Gas Journal, Tulsa, Oklahoma.

CUMBERLAND COUNTY Kentucky—118 acres on Judio Dome, near new shallow production. 5 year term $1.00 rental bonus. Price $20.00 per acre, 1/16 override. Wire, phone: W. V. Cravens, Alpine Motel. Burkesville, Kentucky.

SECONDARY RECOVERY

Lab analysis of cores from recent well indicate 10,000 to 20,000 barrels of pipe line oil **per acre** left in formation after primary **producing** period. Depth 1600'. Can be flooded, **represurred** or mined. This is not an offer for sale.

IMPERIAL-CRAIG CO.
Kevin, Montana.

CAPITAL WANTED

WANTED

$150,000 to drill two wells, new field, new area in Nevada. Over 8,000 acres under lease.

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DELAWARE CORPORATIONS formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

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▶▶▶ Equipment Men Notes

Tretolite Co. makes additions

. . . to its administrative sales staff at the company's St. Louis headquarters, according to Wilbur C. Adams, vice president and general manager.

Amos J. Fox, formerly assistant Latin America division manager at Maracaibo, Venezuela, has been named assistant to Sales Manager James E. Stockton, Jr. Fox will be responsible for an area including the south and southwest United States as well as Latin America. Michael A. Luby, formerly assigned to the special-products department, has also been named assistant to the sales manager. He will be responsible for northwest and eastern United States and all of Canada.

George E. Purdy, who previously headed the special-products department, now becomes technical assistant to the sales manager. Functions of this department will continue as a part of the sales department. Charles P. Siess, Jr., who was assistant sales manager of Tretolite Division, has been named sales manager for Petreco Division at Houston.

Recent additions to Tretolite's field-service staff include: Tommy L. Hayes, formerly with Sinclair Oil & Gas Co., shifted to Seminole, Okla.; Robert J. Weber, previously inspector for Douglas Aircraft Co., now Tretolite's field-service engineer at Cushing, Okla.; and Billy D. Nichols, formerly with Shell Oil Co., presently service engineer at Vandalia, Ill.

Dowell transfers J. R. Paul

. . . to the company's general sales office in Denver, reports R. H. Smith, sales director. Paul was formerly operations manager at Evansville, Ind.

Paul joined Dowell Division of The Dow Chemical Co. in 1946 at Great Bend, Kans., as a service engineer. He was in the company's general offices in Tulsa for 2 years beginning in 1950. From 1952 to 1955 he was district engineer in Kansas. Paul has been at the Evansville district offices since 1955, first as area manager and, since 1957, as operations manager.

National Supply reorganizes

. . . districts within its northwest division, announces R. D. Stottlemyer, division manager.

The northern district, with headquarters at Billings, Mont., includes supply stores at Williston and Charlson, N. D.; Glendive and Kevin, Mont.; and Worland, Wyo. Luther M. Miller is district manager.

The central district, with headquarters at Casper, Wyo., includes a store and a used-equipment yard at Casper and stores at Newcastle, Wyo.; Sidney and Kimball, Neb.; and Fort Morgan, Colo. K. E. Curtis is district manager.

The southern district, headquartered at Farmington, N. M., has a store and a used-equipment yard at Farmington; and stores at Cortez and Craig, Colo.; and Rock Springs, Wyo. G. M. Gaviotis manages the district.

Allis-Chalmers Mfg. combines

. . . its Industrial and General Products Divisions into a new operating unit—the Industrial Equipment Division—with W. M. Wallace its vice president and general manager. G. A. Saar has been appointed assistant general manager. The new division includes the compressor, processing machinery, centrifugal pump, control, and industrial-systems departments, plus the Norwood Works, motor and pump-manufacturing facility.

Canadian Allis-Chalmers, formerly a part of the Industrial Equipment Division, will now operate as a separate division of the Industries Group. H. M. Schudt, president of Canadian Allis-Chalmers, is divisional general manager.

Garrett Oil Tools, Inc. appoints

. . . a new agent to handle sales of Garrett equipment in the Republic of Israel. Raphael Ben Yosef, of Tel Aviv, will represent Garrett in the sale of gas-lift equipment, sleeve equipment, relief valves, Safomatic valves, lease-control systems, motor valves, and drilling equipment. Garrett is a division of U. S. Industries, Inc.

Ed Neely named sales engineer

. . . for the oil-tools department of Avondale Marine Ways, Inc. He will locate in Harvey, La. Before going to Avondale, Neely was with Hydril Co., Sutorbilt Corp., Marshall, Neil & Pauley, Inc., and Southern Engine & Pump Co.

C. E. Lambert assumes position

. . . as assistant general sales manager of Thermoid Division, H. K. Porter Co., Inc., of Trenton, N. J., reports R. W. Christenson, vice president and general manager. Lambert assumes the duties of E. G. Counselman, who will be attached to Porter's general office in Pittsburgh. Lambert comes to Thermoid Division from Porter's Pittsburgh office where he was assistant to the vice president of sales.

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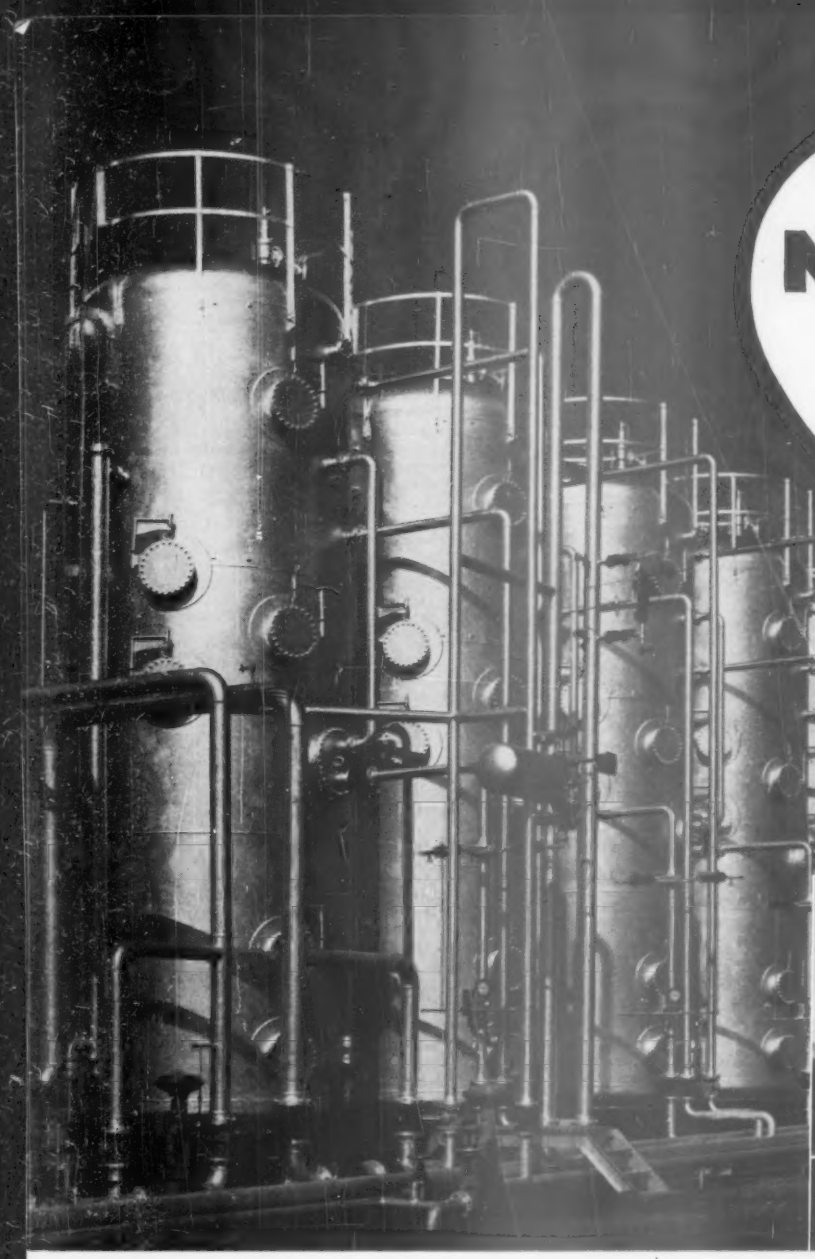

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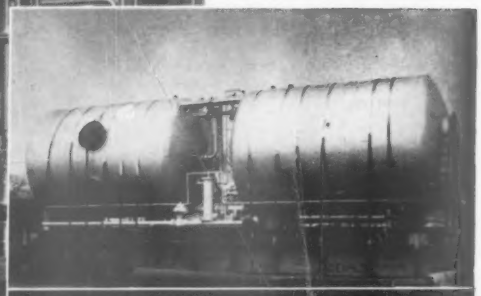

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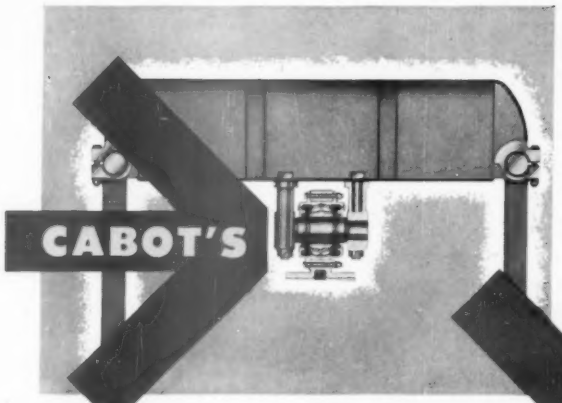

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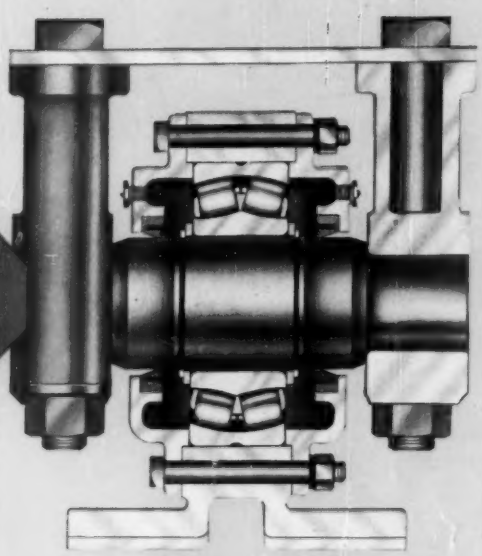

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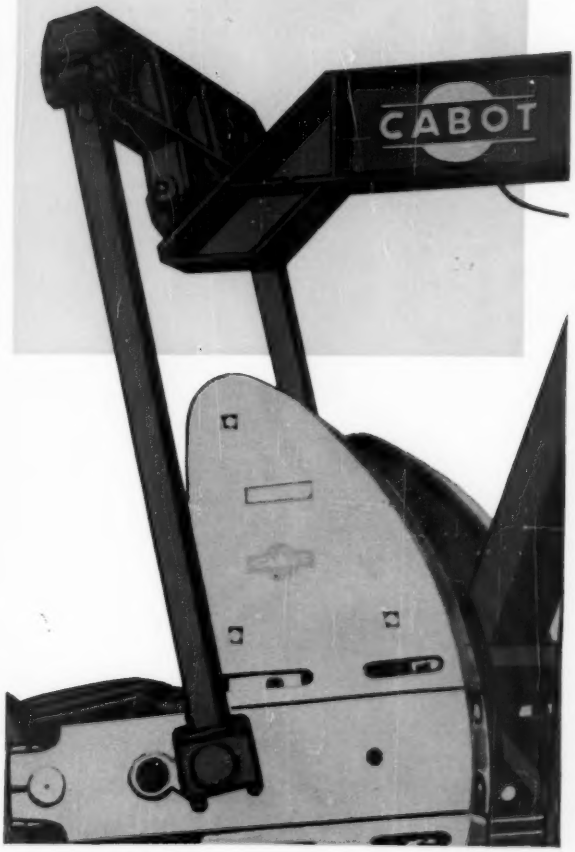

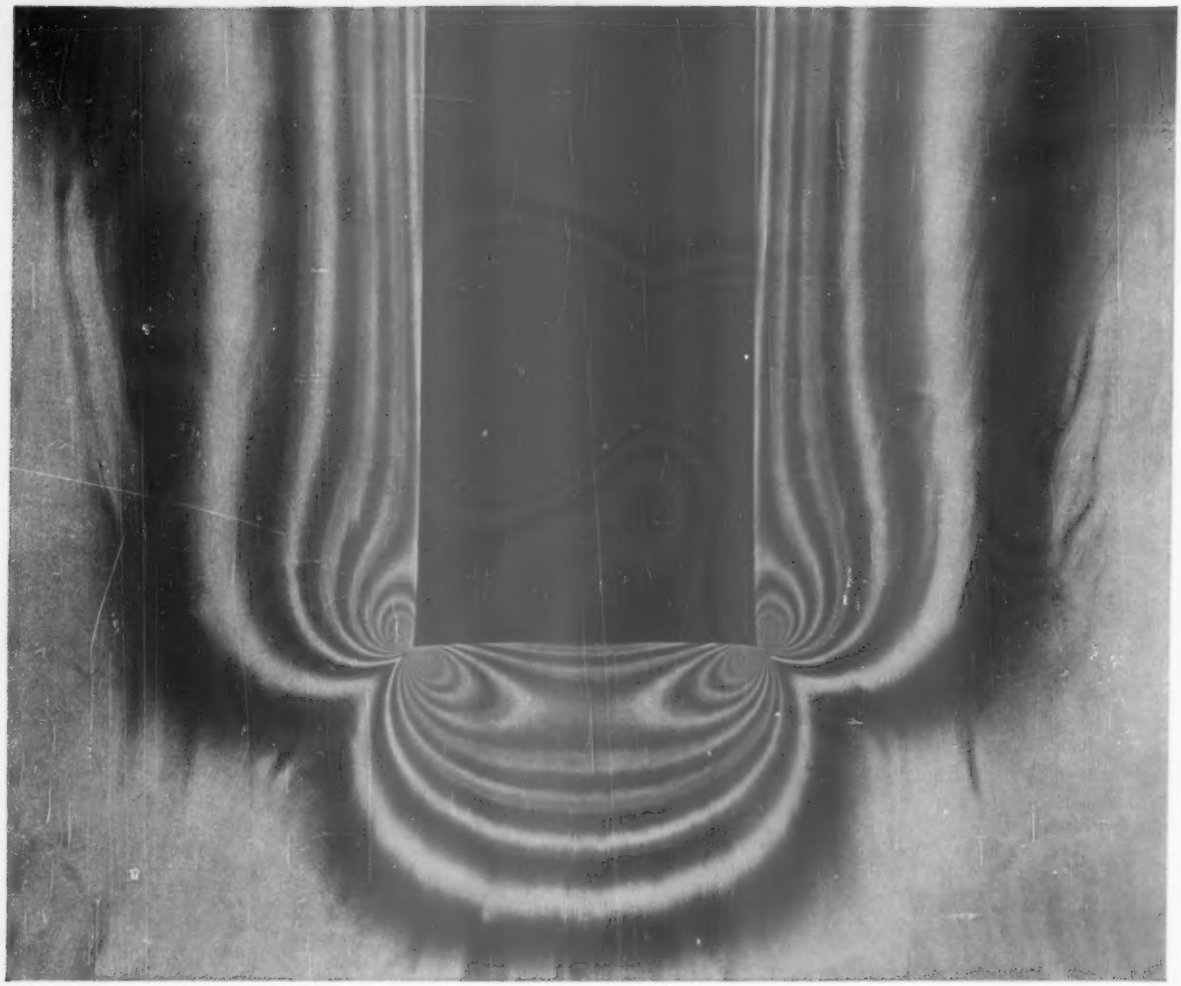

● Well stresses studied for drilling clues

Determining stresses in wells drilled into the earth's crust is the objective of the mathematical and three dimensional photoelastic study being conducted by Hughes research engineers.

It is part of the continuing basic research program being carried on at Hughes to explore a wide range of possibilities for improving bit performance and drilling techniques.

In this study, a hole is drilled into a plastic casting and then forces, which simulate mud column and formation pressures, are applied. The resulting stress distribution is permanently maintained in the model by a technique known as the "Frozen Stress Method." A thin slice is taken from the model and viewed in polarized light. The photograph, above, shows one of these slices. Utilizing the principles of photoelasticity, information obtained from these slices may be used to calculate the stress conditions at any point.

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